Managing overabundant and mobile wildlife: Social and institutional dimensions of kangaroo harvest in South Australia

by

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This thesis is dedicated to my delightful son, Angas.

NOTE: These images are included in the print copy of the thesis held in the University of Adelaide Library.

"The pursuit of truth and beauty is a sphere of activity
in which we are permitted to remain children all our lives"

Albert Einstein

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to this copy of my thesis when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968. The author acknowledges that copyright of published works contained within this thesis (as listed below) resides with the copyright holders of those works.

Thomsen, D. A. and Davies, J. 2005. Social and cultural dimensions of commercial kangaroo harvest in South Australia. *Australian Journal of Experimental Agriculture* **45**:1239-1243.

Thomsen, D. A. & Davies, J. 2007. Improving capacity for the kangaroo industry to benefit South Australian regional communities and rangeland environments. *Australasian Journal of Regional Studies* **13**:1:83-100.

Thomsen, D. A. & Davies, J. 2007. Managing the commercial harvest of a common pool resource: Rules, norms and shared strategies in the kangaroo industry. *Australasian Journal of Environmental Management* **14**:2:123-133.

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Thomsen, D. A., Muir, K. & Davies, J. 2006. Aboriginal perspectives on kangaroo management in South Australia. *The Rangeland Journal* **28**:127-137.

Dana A. Thomsen
December 2007

Abstract

In South Australia, overabundant kangaroo populations are managed through commercial harvest. Kangaroo harvest rates over the past decade have averaged only 40% of the harvest quota despite strong demand for the product. With kangaroo populations increasing, the problem of low kangaroo harvest rate in South Australia requires research attention. Previous research regarding kangaroo harvest has focused on questions of biology and ecology and little attention has been directed towards advancing understanding of the human dimensions of kangaroo management. This research sought to fill this gap in knowledge.

Qualitative research methods were most appropriate due to the focus on social and institutional dimensions of kangaroo management. Data were collected during interviews with people involved in commercial kangaroo harvest: landholders, harvesters and meat processors. The main topics covered were regulations and policy, economic issues, the rights and interests of various industry stakeholders and South Australian harvest rates. The views of Aboriginal people were also sought including the significance of kangaroos to Aboriginal people, access to kangaroos for subsistence harvest, kangaroo management and the kangaroo industry.

The main findings of this research are presented as a series of peer-reviewed articles:

- Article 1 introduces the research topic and presents preliminary findings of this study.
- Article 2 establishes that an increase in South Australia's low harvest rate is needed if kangaroo harvest is to make greater contributions to regional communities, and recommends institutional reform to meet this goal.
- Article 3 examines the management regime for kangaroos in South Australia and shows how the informal rules in use are often incongruent with the formal rules established by management administrators.
- Article 4 describes the undervalued position of landholders in the kangaroo industry and the obstacles to landholders deriving income from kangaroo harvest.

- Article 5 discusses the cultural basis of Aboriginal perspectives on kangaroo harvest and includes suggestions for appropriate ways for Aboriginal people to contribute to kangaroo management.

The main findings of this research were applied in a comparative study of kangaroo management with that of moose management in Finland. This study found that similar social and institutional factors impact on the management of moose and kangaroos. The broad lessons for wildlife management drawn from the comparative study are:

- mobile wildlife resources require flexible management systems
- stakeholder involvement is critical to management
- hunters/harvesters are conservative of their resource base
- declining harvester numbers need to be addressed through support, incentives and training.

These lessons can be applied in part, or in whole, to other overabundant and mobile wildlife species. Thus this thesis makes contribution to kangaroo management by making specific recommendations for the industry, but also contributes to wildlife management in a broader sense through the application of findings to other species.

Acknowledgements

Funding for this project was provided by the Rural Industries Research and Development Corporation (RIRDC), the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) and the South Australian Department for Environment and Heritage (SA DEH). I also received financial support in the form of a scholarship stipend provided by Land and Water Australia.

A large number of people participated in this research. Most importantly I thank the people involved in the kangaroo industry and Aboriginal people who provided their perspectives on kangaroo management and the industry. Without these research participants this thesis would not have been possible.

SA DEH provided harvest data that required considerable work from staff of the kangaroo management program. SA DEH staff were also helpful by providing additional information as required. Indeed, many people from other State government regulatory bodies also provided data and information.

The indigenous component of this research received support and advice from the Aboriginal Legal Rights Movement Inc., in particular Tim Woolley. Also, Yami Lester facilitated field work and provided valuable information and feedback from the inception of this project and for the duration. Kado Muir and Joseph Lennon also provided research support. Lisa Strehlein from AIATSIS provided assistance with understanding the legal framework of Aboriginal rights and interests in kangaroos.

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Understanding and friendship. These people include Louise Moylan, Ben Fleet, Tom Giles, Bhagaraith Chauhan, Shyamantha Bandara, Sukendra Mahalya, Richard Bosworth, Aryn Perryman, Sharna Nolan, Alex Pickburn and Michael Cobiac.

NOTE: This image is included in the print copy of the thesis held in the University of Adelaide Library.

Fellow PhD students (from left) Richard Bosworth, Ben Fleet, Louise Moylan and Tom Giles.

Remote area field work was assisted by Luke Diddams, Luke drove the vehicle, set up camp, cooked the meals, stoked the camp fire, made the tea and helped me clean the vehicle when we returned home. He shared stories, befriended research participants, made everyone feel at ease and kept the field work running smoothly! Thanks Luke.

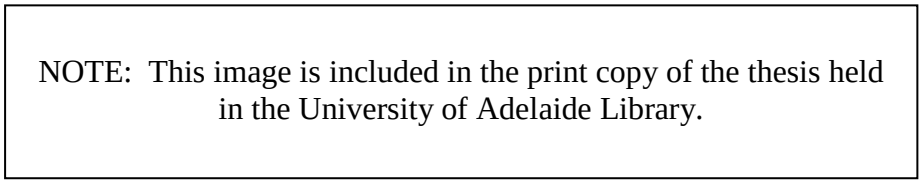
NOTE: This image is included in the print copy of the thesis held in the University of Adelaide Library.

Luke Diddams and his beautiful daughter, Lena.

My greatest thanks is reserved for my research supervisors: Dr Jocelyn Davies, Dr Ian Nuberg, Dr John Hatch and Dr Patricia Murray. Their enduring patience and their support, both professional and personal, provided inspiration and made this PhD process a truly exceptional learning experience.

Special thanks goes to Dr. Jocelyn Davies. The idea for this project was conceived by Jocelyn and she was the driving force behind the project funding. It was Jocelyn's

Insightful advice that directed this research and her faith in me that helped me through the difficult times. Jocelyn is and extraordinary researcher, a motivated supervisor, a treasured friend to me a loving godmother to my son, Angus. Thank you Jocelyn.



Two of my greatest supporters, Dr Jocelyn Davies and Angas Thomsen.

Finally, I would like to thank my family and friends. I would like to make specific mention of my best friend, Sharna Nolan, now living and working in Afghanistan who managed to encourage me from afar. I have many wonderfully supportive friends and family members, and to all I say ‘Thank you”!

Table of Contents

List of Publications

The following publications have arisen from research conducted during PhD candidature and are included in the thesis as individual chapters. Contributions of co-authors are described in authorship statements that appear prior to each article.

Chapter 4 – Article 1

Thomsen, D. A. and Davies, J. 2005. Social and cultural dimensions of commercial kangaroo harvest in South Australia. *Australian Journal of Experimental Agriculture* **45**:1239-1243.

Chapter 5 – Article 2

Thomsen, D. A. and Davies, J. 2007. Improving capacity for the kangaroo industry to benefit South Australian regional communities and rangeland environments. *Australasian Journal of Regional Studies* **13**:1:83-100.

Chapter 6 – Article 3

Thomsen, D. A. and Davies, J. 2007. Managing the commercial harvest of a common pool resource: Rules, norms and shared strategies in the kangaroo industry. *Australasian Journal of Environmental Management* **14**:2:123-133.

Chapter 7 – Article 4

Thomsen, D. A. and Davies, J. 2006. From pest to resource: The prospects for financial returns to landholders from commercial kangaroo harvest. *Australian Farm Business Management Journal* **3**:2:92-102.

Chapter 8 – Article 5

Thomsen, D. A., Muir, K. and Davies, J. 2006. Aboriginal perspectives on kangaroo management in South Australia. *The Rangeland Journal* **28**:127-137.

A significant publication that is not included in this thesis as a chapter is the major report presented to the Rural Industries Research and Development Corporation (RIRDC). The citation for this report is:

Thomsen, D. A. and Davies, J. 2007. *People and the kangaroo harvest in the South Australian rangelands: social and institutional considerations for kangaroo management and the kangaroo industry*. RIRDC Publication No 07/039, February 2007. Rural Industries Research and Development Corporation, Canberra, available on-line at <http://www.rirdc.gov.au/reports/RWS/07-039.pdf>.

Extent of involvement of the student in publications

The majority of the work submitted for this thesis was conducted as a Rural Industries Research and Development Corporation (RIRDC) research project in the Resilient Agricultural Systems program. The indigenous component of the research was funded by the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). Three of the peer-reviewed articles that form the body of this thesis are derived from the reports presented to RIRDC and AIATSIS. All of the peer-reviewed articles are multi-authored but I am the lead author on each. Descriptions of the involvement of each author and their agreement to the inclusion of the manuscript in this thesis are provided in the authorship statement at the start of each chapter in which each manuscript is reproduced in this thesis. A brief overview of the involvement of the authors in each article is provided below.

Article 1: My own work based on preliminary research findings with advice and editorial assistance from Dr. Jocelyn Davies.

Article 2: Drawn from the 2007 RIRDC report that was co-authored by myself and Dr. Jocelyn Davies. I wrote the article based on the content of the report and Dr. Jocelyn Davies provided editorial comment.

Article 3: I drafted this article prior to writing the 2007 research report to RIRDC. Editing by Dr. Jocelyn Davies greatly improved the quality of this article.

Article 4: Drawn from the 2007 RIRDC report with editorial advice from Dr. Jocelyn Davies.

Article 5: Drawn from the AIATSIS report that was co-authored by Dr. Jocelyn Davies, Kado Muir and myself. I prepared and submitted the draft of this article. Significant modifications to the manuscript were required as a result of the reviewer's comments and I undertook the process of revising the manuscript. Dr. Jocelyn Davies and Kado Muir approved the final product.

The Literature Review (Chapter 2) includes parts on kangaroo management that are drawn from the 2007 RIRDC report co-authored by myself and Dr. Jocelyn Davies. Although I was the lead author on this report, Dr. Jocelyn Davies was primarily responsible for the subsection of the report titled, 'Aboriginal people and commercial use of wildlife'.

All other chapters of this thesis are the result of my own work with editorial advice from academic supervisors Dr. Jocelyn Davies, Dr. Ian Nuberg, Dr. John Hatch and Dr. Patricia Murray.

Dana Thomsen
December 2007

Chapter 1

Introduction

Road sign warning that kangaroos are a potential hazard to vehicles on the Stuart Highway, far north South Australia.

Note the word inscribed below the graphic: 'MALU'. This is the Anangu Pitjantjatjara word for red kangaroo.

Introduction

Kangaroos are an Australian icon, a ubiquitous part of the Australian environment, and for many people, a symbol of the Australian bush. Kangaroos are also an economically valuable resource, harvested from wild populations for meat and skins across approximately half of the rangeland and savanna environments that cover 81% of the Australian continent. Kangaroo harvest is an activity that has occurred over millennia. Aboriginal people hunted kangaroos as an important protein source and continue to do so in many parts of the country. Following European settlement the colonisers also found kangaroo, amongst other native species, an important complement to the livestock they had imported (Hornadge 1972).

The European colonisers imported not only livestock, but also farming practices suited to very different environmental conditions. Land was 'improved' by clearing native vegetation and water points for livestock were developed across a dry landscape. A dingo barrier fence was built to exclude native dogs from sheep grazing country and the scene was set for major changes to the Australian biota. This landscape change resulted in the extinction of many small native mammals to the extent that Australia has the dubious reputation as the extinction capital of the world (Archer 2002). However, some native species, such as cockatoos, galahs and most notably, the larger species of kangaroos, thrived in the new conditions. The larger species of kangaroos proliferated to the point where overabundance was, and still is at times, an environmental problem (Young 1996).

In the semi-arid interior of Australia, where livestock grazing is the main land use, total grazing pressure can at times be greater than the carrying capacity of the land (Fisher et al. 2004). The contribution of kangaroos to total grazing pressure is managed by commercial harvest, which provides landholders in the rangelands with a mechanism for managing kangaroo grazing pressure while promoting trade in products from harvested kangaroos (Cairns and Kingsford 1995). Thus, commercial kangaroo harvest occurs as a legitimate part of the management of total grazing pressure on pastoral properties across the rangelands. Kangaroo harvest is regulated under State legislation. Management arrangements vary somewhat between different State jurisdictions, although there is now a move towards greater consistency.

Commercial kangaroo harvest attracts considerable criticism from advocates for animal rights. State government management plans have been challenged through the legal system and the sustainability of the commercial harvest has been called into question. As a result, previous research effort directed towards kangaroo harvest has focused largely on biological and ecological questions in order to assess the ecological sustainability of commercial harvest. There is now a significant body of evidence showing that at no time has the commercial harvest of kangaroos posed a threat to the population viability of harvested species (see for example, Cairns and Kingsford 1995; Pople and Grigg 1999). The focus on biology and ecology has left a gap in knowledge because little research attention has been directed towards advancing understanding of the social and institutional dimensions of kangaroo management.

Research problem, aim and objectives

The problem of focus for this research has been identified as a need to improve the understanding of social and institutional factors in kangaroo management. The broad aim of the research was to investigate the institutional, cultural and economic factors that influence the management of kangaroos in South Australia. More specifically, this research aimed to apply the understandings gained through this research to kangaroo harvest. Therefore the research aim is:

To apply understanding of social and institutional factors to improve the management of kangaroo harvest in South Australia.

During the early stages of this research, objectives to meet this aim were developed. An examination of relevant literature, the review of a report concerning the impact of government policies on kangaroo management (Macarthur 1997) and discussions with government kangaroo management administrators highlighted key issues in relation to the social and institutional factors that influence kangaroo management. The four objectives that directed this research are:

- to explore the reasons for low harvest rate in South Australia
- to analyse institutional settings for kangaroo harvest in South Australia
- to examine stakeholder perspectives and interests in kangaroo management

- to develop an understanding of Aboriginal people's interests in, and perspectives on, kangaroo management and harvest.

Research approach

This research employed mainly qualitative methods. Data was collected from semi-structured, in-depth interviews with people involved in commercial kangaroo harvest. Interviews were conducted in three case study regions with landholders, kangaroo harvesters (or 'field processors') and kangaroo meat processors. The main topics discussed during interviews were regulations and policy for kangaroo management, economics of kangaroo management, the rights and interests of various kangaroo industry stakeholders and South Australian harvest rates. Where appropriate, issues identified by research participants were explored using data from harvest records and by comparison of institutional arrangements in other States.

The views of Aboriginal people about kangaroo management and the kangaroo industry were sought in two 'cultural regions' through community meetings and interviews. Important questions to discuss with Aboriginal people were drafted with the assistance of Aboriginal elders and representatives of Aboriginal organisations. The topics of discussion broadly covered the significance of kangaroos to Aboriginal people, access to kangaroos for subsistence harvest, kangaroo management and the kangaroo industry.

The research has a distinctly South Australian focus which does limit the study to one regulatory environment. It was not feasible to extend the study to other States due to the risk of a less 'in-depth' study overlooking factors which elucidate the relationships between stakeholders that are considered critical to the institutional environment. A further reason for the South Australian focus is that South Australia is considered to be one of the more advanced States in terms of designing a regulatory environment that attempts to directly involve landholders in the kangaroo management system.

Because social and institutional issues were the primary themes of this research, questions concerning stakeholders in kangaroo management and the institutions that govern kangaroo harvest were of key importance. It was therefore necessary to accept some aspects of kangaroo harvest and management as 'given'. Questions of kangaroo

biology, ecology and ethics are not examined in detail in this thesis. Rather, this thesis accepts that the commercial harvest of kangaroos poses no threat to harvested populations (Grigg 2002) and is an environmentally sound management option (Cunningham 1981; Grigg 2002).

Relevance of the thesis

The main contribution of this thesis and its products has been to improve understanding of the social and institutional factors that impact on kangaroo management in South Australia. Of particular importance is the consideration of some of the perspectives held by Aboriginal people regarding kangaroo management and the kangaroo industry. This research has uncovered many issues in kangaroo management that have not previously been discussed in the literature. Issues such as the flexibility required in kangaroo management (Article 3), the landholder view that kangaroos are a resource (Article 4) and the documentation of Aboriginal perspectives on kangaroo management (Article 5) are unique products of this research.

An extension of this thesis is the comparative study of kangaroo management and moose management in Finland along with some other overabundant and mobile species (see Chapter 9). This comparative study found that similar social and institutional factors impact on the management of moose and kangaroos. It concludes that the main findings of this research about kangaroos are also applicable to other mobile, overabundant wildlife resources. The broad lessons for wildlife management are that:

- mobile wildlife resources require flexible management systems
- stakeholder involvement is critical to management
- hunters/harvesters are conservative of their resource base
- declining harvester numbers need to be addressed through support, incentives and training.

Thus, this thesis contributes to knowledge of wildlife management through its findings regarding the social and institutional factors in kangaroo harvest and through the application of these findings to other overabundant and mobile wildlife species.

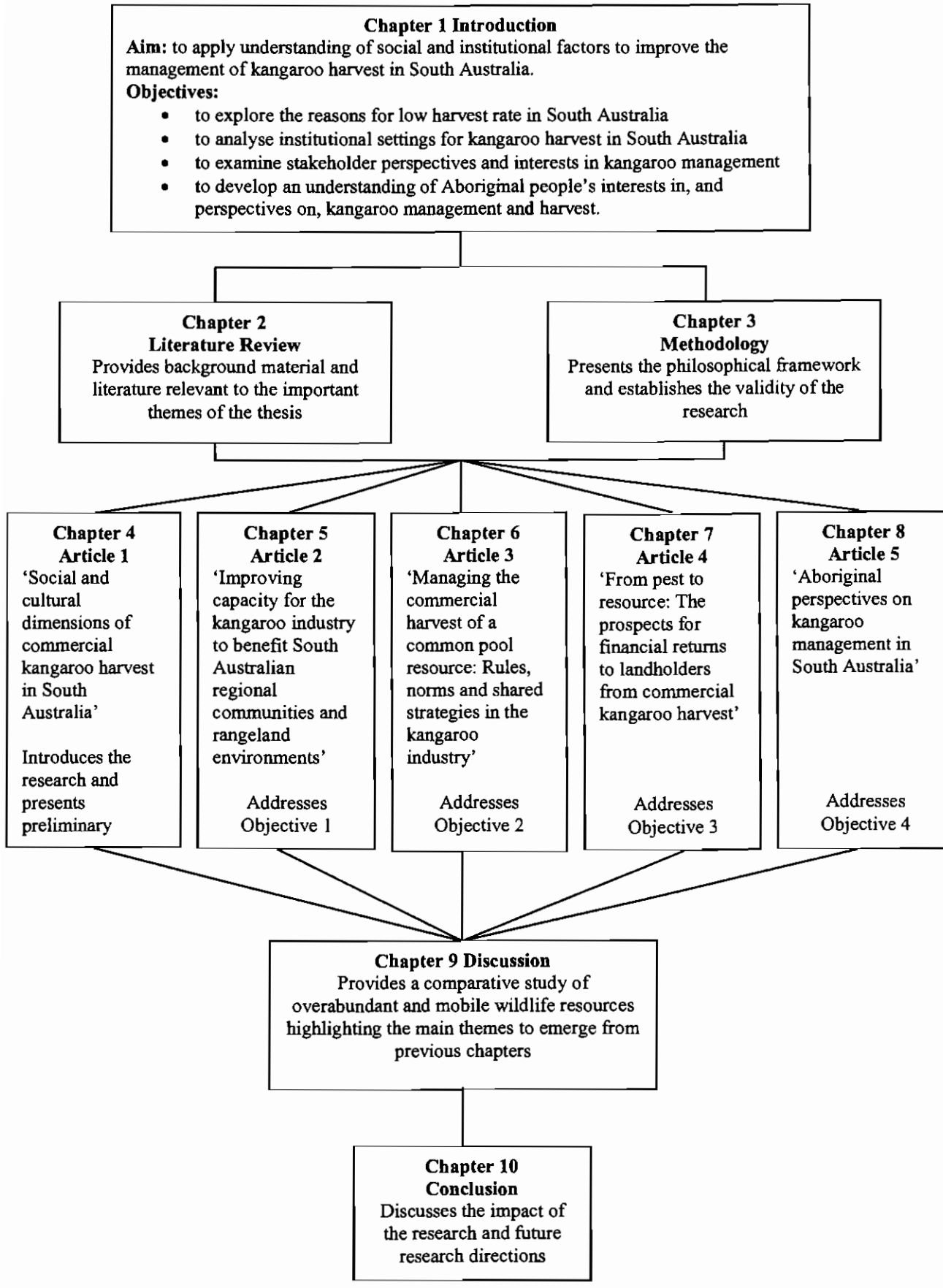
Organisation of the thesis

The organisation of this thesis is outlined below. A diagram that shows the thesis structure follows (see page 8).

- Chapter 1 presents the aims, approach, relevance and structure of the thesis.
- Chapter 2 presents background material from the diverse fields relevant to the study of kangaroo management with a focus on the important concepts that appear in later chapters. It contains sections on wildlife management and e 'tragedy of the commons', wildlife management in Australia generally, and the management of kangaroos specifically.
- Chapter 3 describes the methodology that underpins this research, from the philosophical framework to the selection of methods, with a focus on explicitly examining the validity of this research.
- Chapter 4 presents the first of the published papers. Article 1, titled 'Social and cultural dimensions of commercial kangaroo harvest in South Australia', was accepted for publication at an early stage in the research process. It introduces readers to the research topic and presents preliminary findings.
- Chapter 5 explores the problem of South Australia's low harvest rate with particular focus on how kangaroo harvest can make greater contributions to regional communities. Article 2 is titled 'Improving capacity for the kangaroo industry to benefit South Australian regional communities and rangeland environments'.
- Chapter 6 examines the management regime for kangaroos in South Australia with a focus on the formal and informal rules, norms and shared strategies. The title of Article 3 is: 'Managing the commercial harvest of a common pool resource: Rules, norms and shared strategies in the kangaroo industry'.
- Chapter 7 examines the place of landholders in the kangaroo industry and the potential for kangaroos to contribute to on-farm income. This issue is explored in Article 4 titled: 'From pest to resource: The prospects for financial returns to landholders from commercial kangaroo harvest'.
- Chapter 8 presents the views of Aboriginal research participants regarding kangaroo management and the commercial harvest of kangaroos. The title of Article 5 is: 'Aboriginal perspectives on kangaroo management in South Australia'.

- Chapter 9 draws together the main themes that emerge from the papers presented in the thesis. This is achieved through a study that compares kangaroo management with literature based research about moose hunting in Finland. This comparative study highlights the transferability of the research findings and allows conclusions to be drawn about the management of overabundant and mobile wildlife.
- Chapter 10 outlines conclusions and discusses the impact of the research on kangaroo management practice in South Australia and proposes directions for future research.

Thesis structure



Chapter 2

Literature review

Red kangaroo, *Macropus rufus*, near Ooraparinna, Flinders Ranges, South Australia, January 2004.

Introduction

Kangaroos have been harvested throughout Australia's human history. Prior to European settlement Aboriginal people harvested kangaroos using cultural protocols that maintained the resource. However, during Australia's early European history kangaroos were an open-access resource exploited for their valuable meat and skins without constraint (Hornadge 1972; Poole 1984). In particular, the high value of kangaroo skins led to overexploitation during times of drought when kangaroo populations experienced natural reduction (Lines 1991). The big drought of the 1960s brought the problem of unregulated kangaroo harvest to the fore. Bailey (1971) tracked kangaroo movements during the drought and showed that almost half of the kangaroos were shot by kangaroo harvesters during the period of the study. To many people the results suggested that exploited kangaroo species were potentially under threat and the public confronted governments with their concern.

This story of the transition of kangaroo harvest from unregulated, open-access to an organised and regulated industry is described in some detail later in this chapter. The first task of this chapter is to establish the main features of wildlife as a common pool resource and to examine the range of practical management solutions that can be employed for such resources. A brief history of wildlife management in Australia follows and leads into an explanation of contemporary kangaroo management.

Common pool resource: a definition

A common pool resource is a resource, either natural or man-made, to which a "large number of people have access" (Dietz et al. 2002:3). Some examples of common pool resources are oceans, lakes, forests and rivers. A defining feature of a common pool resource is that it is difficult to exclude people from accessing the resource (Ostrom 2005). Ostrom (2005:79-80) explains that "one person's consumption of resource units, such as water, fish or trees, removes those units from what is available to others." When the resource units are valuable and rules governing resource extraction are lacking, individuals may be motivated by this value to overuse the resource and cause damage to the resource base (Ostrom 2005). This propensity towards overexploitation of common pool resources has been described as the 'tragedy of the commons' (Hardin 1968).

'Tragedy of the commons'

For thousands of years, scholars have discussed the issue of common resource use. Two thousand years ago Aristotle recognised "what is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest" (quoted in Carpenter 1998:42). But it was the 1960s that produced two major influences that would shape the development of contemporary common resource theory: the book 'The Logic of Collective Action' by Olson (1965) and the brief but seminal essay 'The Tragedy of the Commons' by Garrett Hardin (1968). Each of these authors proposed that when individuals use common resources the system is vulnerable to unsustainable levels of exploitation due to the conflict that arises between self-interest and common interest. Olson (1965) explained the phenomenon in terms of the opportunistic behaviour of individuals and the propensity to 'free-ride', asserting that individuals will only act for the benefit of collective interests when they are coerced into doing so. Hardin (1968) presented the problem as inherent tragedy of overexploitation and resource degradation using the example of the pastoral commons. In this parable, communally owned pasture is used for grazing animals owned by individuals. Each individual herder benefits by adding a single animal to their herd, but the cost to the individual of adding that animal to the herd is calculated as the resources used by that animal divided by the total number of users of the pastoral common. All herders add additional animals for their personal gain to a point where the system cannot sustain the total herd. Thus, Hardin (1968:162) concludes, "freedom in a commons brings ruin to all".

Hardin's 'tragedy of the commons' has become a metaphor that is applied to a myriad of problems involving natural resource degradation from forestry to irrigation systems and wildlife (see for example, Smith and Berkes 1991; Brown and Harris 1992; Bardhan and Dayton-Johnson 2002; Basurto 2005). However Hardin's thesis has been criticised by numerous authors (see for example Crowe 1969; McCay and Acheson 1987; Smith and Berkes 1991; Ostrom et al. 1999; Dietz et al. 2003). The main criticism is that it provides for only two solutions to the commons problem. The first solution is government control and regulation of resource users because, as Ostrom et al. (1999:278) point out, in the Hardin model "users are pictured as trapped in a situation they cannot change". The second solution is to assign and enforce private

property rights over the commons. In this alternative, each individual holder of private property rights has the incentive to protect their portion of the commons as it is solely theirs to benefit from (Smith 1981). But Ostrom (1990:1) asserts that "neither the state nor the market is uniformly successful in enabling individuals to sustain long-term, productive use of natural resource systems".

Critics of Hardin's thesis also point out that not all commons situations result in a tragedy. McCay and Acheson (1987) discuss some of the assumptions of the 'tragedy of the commons' model including: common pool resources are subject to open access, resource users are selfish and have complete information, and resource extraction is of a volume high enough to result in degradation. It is generally agreed that these assumptions do not always apply and the context for common pool resource problems varies widely (Edwards and Steins 1999). Common pool resource problems may hold the potential for tragedy but whether a tragedy actually results is dependent on the context of resource use (McCay and Acheson 1987; Edwards and Steins 1999) and whether individuals or groups appropriating from the commons take collective action to conserve their common interest (Ostrom 1990; Brown and Harris 1992).

Ostrom (1990) argues strongly that there are more possible solutions posed to the 'tragedy of the commons' than the two posed by Hardin. In terms of broadly defined solutions to the 'tragedy of the commons' problem there are three main institutional types for common pool resources: private property rights, government control and community control, that is, the presence of social controls/rules held by a community (Brown and Harris 1992). Furthermore there are many combinations, or hybrids, of these three institutional types that can be used to control access to common pool resources (Gadgil and Iyer 1989; Carpenter 1998; Ostrom 1999; Berkes 2002; Schlager 2002; Basurto 2005). The management of wildlife, a common pool resource, holds examples of the broad three institutional types and hybrids. In the following section, the application of these different types of solutions to the 'tragedy of the commons' problem is examined in the context of wildlife management.

Wildlife management and solutions to the 'tragedy of the commons' problem

As Riney (1982) observed wildlife and people are closely linked. Wildlife provided the earliest humans with food, clothing and shelter and the practice of wildlife harvest and management has origins in earliest human history (Cairns and Kingsford 1995). Aldo Leopold (1933) in his classic text, *Game Management*, provides a comprehensive historical record of wildlife management and points to an origin in tribal taboos. Leopold cites the work of Taverner (1930) who postulated that the tribes that developed and followed social controls to restrict harvest of particular animals and plants by certain people or at certain times were more successful than tribes that did not have such controls in place.

This early example shows that there will inevitably be social factors to consider in developing and applying wildlife management strategies (Riney 1982). Amongst the social issues that wildlife managers must consider are the values that people attribute to wildlife. These values differ for a range of reasons including environment, culture, social norms and economic concerns (Purdy and Decker 1989; Aslin and Norton 1995). Rittel and Webber (1973:160) identify such policy problems as 'wicked' problems because they "are ill-defined and they rely upon elusive political judgement for resolution."

As wildlife management cannot be separated from value judgements, culture and other social issues (Berkes 2004), social sciences are critical in the study of wildlife management (Fitzhardinghe 1994) and a multidisciplinary approach to solving wildlife problems is widely recommended (see for example, Holling and Meffe 1996; Chase et al. 2000; Suchet 2001; Gordon et al. 2004; Rudd 2004). As introduced above, there are three generally accepted institutions for solving 'tragedy of the commons' problems: government control, privatisation and community control. The following section explores how the 'wicked' problem of wildlife management is addressed in contemporary management regimes using these three institutions and the increasingly applied hybrid institution, co-management.

Government control of wildlife resources

In most countries a centralised approach to the management of common pool resources is used. The general philosophy follows Hardin's 'tragedy of the commons' theory that resource users will inevitably overexploit common pool resources if left to their own devices (Freeman 1989). Thus, the most common solution to the 'tragedy of the commons' problem has been for governments to regulate and monitor resource use and compliance. This is also the case for wildlife where the responsibility for the protection of wildlife and regulation of harvest belongs to governmental departments (Gordon et al. 2004).

Government control of wildlife may enable individuals and groups to utilise wildlife species at the discretion of the State (Bromley 1992). For example, in the USA deer hunting is a regulated activity; in Finland moose are harvested according to quotas set by government departments; and in Australia State governments regulate and monitor the commercial harvest of kangaroos. These examples are considered in more detail in Chapter 9 through a comparative study that focuses on kangaroo management and the management of moose. For kangaroos, moose and deer, government control ensures ecologically sustainable harvests. However, the bureaucracy of government control of common pool resources has often under-valued the importance of the social context of management strategies (Holling and Meffe 1996; Notzke 1995).

Less-developed countries also experience problems with government control. Feeny et al. (1990:12) state that "in much of South Asia, Africa, and elsewhere, poorly-defended State property, in conjunction with population pressure, has led to widespread poaching". They conclude that sustainable resource use is seldom facilitated by government control in less-developed nations due to poaching of economically valuable species. In some less-developed countries the solution to the 'tragedy of the commons' problem has been the privatisation of wildlife resources. This is the topic of the next section.

Private property rights

Hardin (1968) and others (see for example, Smith 1981; Mendelsohn and Balick 1995) advocate private property rights as an option for avoiding overexploitation and degradation of common pool resources. In early English common law, "wild animals

had no owners until they were captured" although some qualified rights to wildlife were granted to landowners (Lueck 1989:293). By the mid-1800s English law vested wildlife ownership with landowners. However, the United States and Australia did not follow the same path. In these countries wildlife ownership has never been granted to landowners. Rather wildlife is 'owned' by the people and managed by governments (Lueck 1989). The effect of government regulation of wildlife utilisation is that Australian landowners, and pastoral lease landholders, have very limited property rights in wildlife. This is very different to some other countries, such as Zimbabwe, where wildlife resources have been extensively privatised.

In the late 1970s, a handful of visionary commercial farmers in Zimbabwe became wildlife production pioneers. The transition from livestock production to wildlife production was made possible because landowners were granted the right to manage and benefit from wildlife on their property under the *Parks and Wildlife Act* 1975 (Murphree 1993). Initially the concept was met with considerable reluctance from landholders, but two decades later wildlife production expanded to become the dominant form of income for many Zimbabwean farmers (Suzuki 2001).

Suzuki (2001) reports that a survey conducted by the World Wide Fund for Nature in the early 1990s found that ranches operating on wildlife production as the sole business activity were more financially viable than ranches devoted to livestock production and ranches where income was sought from both livestock and wildlife. The high monetary value of wildlife in Africa is a major factor in the success of enterprises based on wildlife production. In 2004, six buffalo sold for around A$210,000 and white rhinos fetched over A$50,000 each at Kirkwood, a small wildlife game reserve in South Africa. The sale of wildlife in the province of KwaZulu Natal netted a total of A$10 million in the same year (Hayward 2005).

Privatisation has increased awareness of the value of wildlife in South Africa, Zimbabwe and other African countries. But is privatisation ensuring conservation and solving the 'tragedy of the commons' dilemma? As Hutton and Dickson (2001:451) propose, "to generate income from wildlife is one thing, to ensure that this contributes to conservation is another". In southern Africa, private ownership has re-introduced species that were locally or regionally extinct. But for other species, where wild

populations are fenced in, disruption of gene pools can become a problem (Reid et al. 2004). Nonetheless, over the past two decades wildlife numbers and diversity in southern Africa have consistently increased. Barnes and de Jager (1995) attribute this increase to the introduction of private property rights to wildlife.

Smith (1981) argues that private property rights deter overexploitation because appropriators of the resource have incentive to ensure sustainable utilisation. However, it is not always necessary, or even desirable, to demarcate private property rights to solve the 'tragedy of the commons' problem (Ostrom 2005). Attributing private property rights to wildlife can introduce problems of equity. Is it ethical to hand over ownership of wildlife to landholders when other members of society also have some stake? In Zimbabwe privatisation has caused conflict amongst the rural poor who utilise wildlife for subsistence and for trade (Moyo 2005). Where landholders once chased wildlife from their lands, they now encourage wildlife onto their properties. The move from perceived 'pest' to valuable resource has resulted in restricted access to wildlife resources for neighbouring communities. In some parts of Africa, communities have been granted local control over wildlife resources (see for example, Child 1996; Alexander and McGregor 2000). In the next section the ability of local communities to devise their own institutions for sustainable extraction from wildlife resources is discussed.

Community ownership

In recent decades hundreds of common pool resource regimes have been studied and documented (Hess 2003). These studies have covered diverse common pool resources including water, forests, grazing lands, fisheries and wildlife (for example McCay and Acheson 1987; Berkes 1989a; Ostrom 1990; Buck 1999; Basurto 2005). Many examples of localised, communal institutions that demonstrate successful management of common-pool resources exist (Agrawal 2001). Three significant works on community-based management of common pool resources have specifically shown that community groups can design and implement institutions to manage common pool resources sustainably (Wade 1988; Ostrom 1990; Baland and Platteau 1996).

Ostrom (1990) provides numerous examples of successful community control regimes for managing common pool resources over the long term. In particular she discusses in some detail self-governing institutions for grazing lands, forests and irrigation systems. However, examples of community control regimes for managing wildlife resources are not well-represented in the literature. In the past hunter-gatherer societies managed wildlife resources for community benefit but, as Gibbs and Bromley (1989:29) state, such localised and community based management regimes for wildlife "have greatly declined with increasing pressure on the land resources from the expansion of agriculture, commercial forestry and mineral-exploitation activities".

Berkes (1989b) provides an example of a community institution for common pool resource management in the indigenous management of beaver harvest in the James Bay district of Canada. Here, the Cree Indian community of Chisasibi use a traditional management system to avoid overexploitation. The system involves a tribal member, or 'boss', bearing responsibility for the use of beaver in a particular region. The boss manages the harvest for communal benefit by supervising harvest and sharing of the catch and enforcing customary rules for hunting behaviour. Berkes (1989b) reports that cooperation amongst the resource users has maintained beaver populations in the region and ensured productive harvests.

Another example of local resource appropriators achieving a sustainable resource extraction regime is that of sea-urchin harvest in St. Lucia, West Indies. Smith and Berkes (1991) describe the communal management regime of the Laborie villagers. Local people conduct sea-urchin harvest during a defined time period each year and exclude outsiders and locals from harvest at other times. The community successfully enforces the seasonal harvest in the small bay where the village is located. The result of communal control of sea-urchins in the Laborie region is sustainable harvest.

Some of the important factors that are needed to produce an institution capable of a sustaining common pool resource over the long term are present in these examples. Agrawal (2002) provides comprehensive discussion of these factors, as summarised in Table 1. The conditions that facilitate sustainable common pool resource management include characteristics of the resource, the management group, institutions and the

external environment. The common features of the examples discussed above is that all resource users are accountable to other users and resource appropriation is monitored and sanctioned. That is, institutional arrangements are in place facilitating sustainable management. Furthermore, there are well-defined boundaries that delineate the extent to which the local institutions operate. A problem for local management institutions is that for some resources boundaries are not well-defined. Some wildlife species are highly mobile, as is the case for kangaroos, moose and some other species (as discussed in Chapter 9).

Table 1: Conditions facilitating sustainable common pool resource management

NOTE: This table is included on page 18 of the print copy of the thesis held in the University of Adelaide Library.

Source: Adapted from Agrawal (2002).

Wildlife populations that move across boundaries of political and institutional dominion may not be amenable to management under the three classes of common pool resource management institutions introduced above. Government control of mobile wildlife species can create difficulties when animals move across political boundaries because the management of wildlife in one sovereign State can greatly differ to the management principles of its neighbour. Privatisation of wildlife resources, and in some circumstances government control, can overlook the needs and aspirations of local people in wildlife management. Nevertheless, local people are closest to wildlife resources and their cooperation is critical to management outcomes. But, as the above discussion suggests, local institutions are not always well-equipped to manage mobile species because small resource size and well-defined resource

boundaries are often necessary for successful management. As none of the three main solutions to the 'tragedy of the commons' problem is well-suited to the management of mobile wildlife species, hybrid institutions that incorporate government and local level management have become prominent in wildlife management. In the next section, co-management is presented as a hybrid institution with potential to address the mobility problem.

A hybrid institution: co-management of wildlife

Co-management attempts to bring together government and local institutions for management of natural resources. Although there is no universally common definition of co-management, numerous authors (such as Notzke 1995; Rusnak 1997; King 2004; Plummer and Fitzgibbon 2004) refer to a definition provided by Berkes et al. (1991:12) who describe co-management as "the sharing of power and responsibility between government and local resource users". It is appropriate that there is no single definition of co-management because there are a range of levels of power sharing that can be present in different co-management arrangements. Pimbert and Pretty (1997) use a structure similar to Arnstein's (1969) 'ladder of citizen participation' to describe the varying degrees of power sharing between government and the public that range from 'passive' involvement to 'self-mobilisation' based on the management responsibilities that are divulged to the community or public (see Figure 1).

Ladder of citizen participation (Arnstein 1969)		Typology of participation (Pimbert and Pretty 1997)
Citizen Control		
Delegated power	Degrees of citizen control	Self-mobilisation
Partnership		Interactive
Placation		Functional
Informing	Degrees of tokenism	Incentives
Consultation		Consultation
Therapy	Non-participation	Information giving
Manipulation		Passive

Figure 1: Arnstein's (1969) ladder of citizen participation (left) 'spliced' with Pimbert and Pretty's (1997) typology of participation (right)

Arnstein's (1969) argument for citizen participation in government decision-making was based on the right of individuals to be involved in matters that concern or affect them. But more recently the principle of subsidiarity has emerged, calling for "decisions to be located at the lowest possible political-administrative level" (Ribot 2003:57). The main impetus for this principle in wildlife management is that long-term objectives are easier to realise with the help of local people than without. Lane et al. (2004) use the subsidiarity principle to describe how decisions about resource use and management are best made at the institutional level closest to the people affected by the decisions. Most co-management regimes and other hybrid institutions, such as community-based wildlife management, have not yet embraced the sudsidiarity principle (Ribot 2003). Nonetheless, there are many wildlife co-management arrangements in operation throughout the world that are delivering outcomes for wildlife and local people.

Many examples of co-management are covered in the Australian literature. Of prominence are co-management arrangements with indigenous people (see for example, Davies et al. 1999; Smyth 2001; Palmer et al. 2002; Walsh and Mitchell 2002). The co-management of sea-turtles in Arnhem Land by local indigenous people, scientists, governments and other stakeholders is one such example. Kennett et al. (2004) have documented how the Yolgnu people have entered into co-management

arrangements in order to protect sea-turtles, migratory species that spend part of their lives in Yolgnu country. Yolgnu have harvested sea-turtle for countless generations but the turtles are now threatened by environmental degradation along coasts that support nesting and foraging, and marine debris which entangle turtles and other sea creatures. Through the Dhimurru Aboriginal Land Management Aboriginal Corporation Yolgnu are working with commercial and recreational fishers, scientists, government organisations and overseas stakeholders to promote understanding of sea-turtle migration patterns and reproduction and to control threats to the species. In this case, as with most other Australian examples of co-management of natural resources with indigenous people, the responsibility for most decision-making remains with government resource managers (Davies et al. 1999; Dhimurru 2006). An exception is the co-management arrangement in place at Uluṟu-Kata Tjuṯa National Park in central Australia where Aboriginal people form a majority on the board of management (De Lacy 1994).

Co-management also features in the efforts of other countries to manage mobile species with the cooperation of indigenous people. A hybrid management system is in place in the United States for the management of Pacific salmon, a species that migrates through numerous waters and regulatory regimes. In Washington State a cooperative arrangement exists between indigenous managers and the State (Ross 1999; Ebbin 2002). The combination of indigenous knowledge and management techniques with the scientific knowledge, funding and coordination functions of the government has resulted in improved management of the salmon fishery. Also the decentralisation of decision-making has allowed greater accommodation of the social and cultural needs of the indigenous community (Ebbin 2002). However, possibly the greatest benefit that hybrid institutional arrangements for wildlife management can deliver is to address issues of resource mobility. Local people are unable to influence how others extract from the resource when it has migrated from their lands. Thus cooperative arrangements between local people and governments are most suited to the management of mobile wildlife resources, such as the examples above. Similar positive outcomes have been realised in the co-management of other common pool wildlife resources, such as polar bears (Notzke 1995) and caribou (Kendrick 2003) in Canada, muttonbirds in New Zealand (Taiepa et al. 1997) and a variety of wildlife

species in some African countries (Hackel 1999; Songorwa et al. 2000; Twyman 2000) and southeast Asia (Steinmetz et al. 2006).

Co-management, involving government and local institutions, integrates the knowledge and resources of both institutions to effect sound resource management and outcomes for local people (Borrini-Feyerabend 1996; Berkes 2002). The joint participation of local people is the cornerstone of co-management and the devolution of genuine responsibility and decision-making power is critical (Greening and Gonzales 1999). It follows then that a potential problem with co-management lies in government reluctance to devolve power to local institutions. Borrini-Feyerabend (1996) identifies 'mild co-management' where decision-making remains with the State and local people are called on in an advisory role. But Taiepa et al. (1997) argue that an advisory role does not constitute co-management. In Figure 1 (page 20) such an approach to participation could be placed in the category of non-participation, or at best, tokenism. Genuine co-management involves power sharing and should fall into the category of degrees of citizen control in Figure 1. However, relinquishing decision-making power can be a contentious issue for governments and bureaucrats (Taiepa et al. 1997).

Wildlife management problems are complicated in that they involve not only questions of ecology and population biology of different species but also the interests of many different people. This section has shown that a variety of institutions have been used to manage common pool wildlife resources. In finding solutions to 'tragedy of the commons' problems concerning wildlife, different institutions fit different situations, resources, societal values and objectives. However, in the management of mobile wildlife species, cooperative arrangements between local people and governments seem to be most effective. In the next section, the development of wildlife management in Australia is traced from its earliest beginnings, that is, of the local management systems of indigenous people, through the open access era of European settlement, to the more recent regime of government control of wildlife.

Wildlife management in Australia

Indigenous wildlife management

For over 40,000 years Aboriginal people harvested and maintained the native flora and fauna (Lourandos 1997). However, whether natural resources are managed actively and consciously or as a result of cultural practice, is a point that has been sometimes debated (Isaacs 1987; Williams 1998). Nonetheless, the way that Aboriginal people utilised living resources sustained countless generations of people. The classic feature of Aboriginal land management was for family or clan groups to move across the landscape, within a defined region, in order to allow the plants and animals to recover in one area while exploiting the resources of another area (Collins et al. 1996). Social rules governed the utilisation of wildlife (see Article 5 in Chapter 8) and like other hunter-gatherer societies, these social rules were local institutions for avoiding the 'tragedy of the commons'.

Over many thousands of years of continuous occupation, Aboriginal people had a complex impact on the Australian environment (Kohen 1995). Fire-stick farming practices facilitated hunting, promoted new growth for herbivores and regenerated the land. In this and other ways the landscape was modified to meet their subsistence needs and support their economy (Davies et al. 1999; Garden 2005). Thus, when the First Fleet sailed into Botany Bay in 1788, the passengers did not encounter a pristine, untouched environment but an environment significantly shaped by the activities of the Aboriginal inhabitants (Lines 1991; Kohen 1995; Rolls 2000).

Contact, colonisation and extinction

At the time of colonisation, the colonisers considered Aboriginal people a primitive, nomadic people who had little impact on the land. Australia was declared *terra nullius*, a land of no-one, an empty and unutilised land (Mattingley and Hampton 1988). This conviction has only relatively recently been unseated by the High Court, which in 1992 heard the famous *Mabo and others vs Queensland* case, finding that native title to land exists (Hill 1995). But to the eyes of the British settlers in 1788, the Australian landscape lacked a past. They found no familiar signs of permanent dwellings, animal husbandry and cultivation (Lines 1991; Rolls 2000). An understanding of the impact of Aboriginal people on the Australian landscape,

unrecognised at this time, would await detailed exploration and elucidation much later.

To the British colonists the new land was unfamiliar and monotonous (Reeve 1988). However peculiar the wildlife seemed to the first settlers, the native animals and birds proved an important source of protein (Garden 2005). As Hornadge (1972:8) states, "there were times when the small settlement at Port Jackson faced starvation and hunting everything that moved became grim necessity". As the colony grew and became better able to support itself with produce from imported livestock and plants, native animals such as the kangaroo went from being a food source to a source of interest or sport. British preconceptions of society, development, recreation, nature and landscape meant that the settlers longed for the familiarity of all things English (Heathcote 1976). A desire to recreate English landscapes led to the formation of societies to introduce exotic species to Australia. Acclimatisation societies operated in most Australian States by the 1860s with a mandate of naturalising foreign flora and fauna.

The earliest Australian attempt to protect wildlife was the *Animals Protection Act* 1879 (New South Wales). The Act was constituted for two main purposes: "to encourage the importation and breeding of game not indigenous to the Colony; and, to prevent the destruction of native game during the breeding season" (cited in Strom 1979:49). Strom (1979) points out that no native mammal was included in the list of animals protected under that Act. Rather, the Act protected imported game animals such as antelope, partridges, grouse and deer. The only indigenous fauna protected were some bird species, including the black swan (Strom 1979). Frawley (1992) describes the main issue as one of perceived economic value. Native animals were considered to be economically insignificant (Lines 1991).

With expansion of the colony and economic growth of paramount importance, native animals and vegetation were seen as obstacles to development (Lines 1991). Thus, early wildlife management amounted to little more than the extermination of perceived threats to the expansion of agriculture. Open-access to wildlife and high international demand for fur encouraged exploitation and large numbers of native animals were killed for the fur trade. In South Australia, the koala became locally

extinct after which the response was to hunt possums instead (Lines 1991). In the three year period from 1919-1921 the furs of 5.8 million Australian mammals were traded (Hutton and Connors 1999). During this period of wildlife exploitation, even extermination, concern was growing amongst a small group of mostly professional people. Some predicted the demise of Australian native mammals and a prominent spokesperson for the cause was David Stead (Hutton and Connors 1999). In the early 1900s Stead wrote a series of articles, published in the *Sydney Morning Herald*, as he tried to raise public awareness of the need to preserve Australian native animals.

People such as Stead were concerned for good reason. During the late 1800s and early 1900s extinctions were occurring at a rapid rate. Although native mammals were exposed to great hunting pressure, Short and Smith (1994) state that hunting played a minor role in the local and widespread declines of the time. They attribute the decline to the introduction of predators such as cats and foxes, altered fire regimes, habitat clearing for agriculture and the introduction of grazing animals such as sheep, rabbits and cattle. The small and medium sized native mammals were most affected. The once common brown hare-wallaby was extinct by 1890; the brush-tailed rat kangaroo once abundant in the eastern States was found only in Western Australia by 1900; and the banded hare-wallaby had disappeared by 1906 (Bolton 1992). These examples, and many others, have earned Australia the reputation of being a world leader in species extinction (Archer 2002). Fifty percent of the mammal species that became extinct world-wide in the last 200 years were Australian (Short and Smith 1994).

Federation, nationalism and the rise of the conservation ethic

Prior to Australia's federation in 1901, all of the Australian States were autonomous bodies each with their own governing legislation. Federation did not result in the States handing over all legislative power to the Federal Government. Rather the States retained legislative providence over most public services including hospitals, schools, roads and wildlife (Ward 1995). Thus each State is the "constitutional guardian of the flora and fauna within its boundaries" (Marshall 1966:216). Each State approached the management of wildlife differently, but all made little effort to protect or manage wildlife until the conservation movement of the 1960s placed wildlife management firmly on the agenda of Australian politics.

An environmental awareness emerged in Australia post World War II that Frawley (1992:227) attributes to a "sense of national pride" that stimulated interest in Australian landscapes, flora and fauna and generated an Australian public more supportive of conservation issues. By the late 1950s and early 1960s the public was becoming vocal and active regarding the conservation of native wildlife. The modern environmental movement had fully emerged in Australia by the mid 1960s (Powell 1992). Between this time and the early 1970s national and State wildlife protection societies were formed in response to growing public awareness (Mosley 1972; Hutton and Connors 1999; Garden 2005).

In 1966, Jock Marshall further raised the profile of the issue of wildlife conservation when he produced the book 'The great extermination: a guide to Anglo-Australian cupidity, wickedness and waste' (Bolton 1992). Marshall criticised Australian wildlife management and conservation efforts, lamenting "we often accuse ourselves of becoming 'Americanised'. I often think that it would be pleasant if we really were. The conservation programme of the United States is an object lesson to us Australians" (Marshall 1966:209). Writing in the early 1970s, Frith (1973:3) had similar reservations about the development of Australian wildlife management and stated that although wildlife management had been discussed for a number of years, "so far it has not progressed much beyond the talk and juggling of open seasons and bag limits".

However, in recent decades wildlife management has become formalised, bureaucratic, scientific and professional. Management plans that incorporate scientific information with the needs and values of the public are in place for parks and reserves, forests, wetlands, endangered and threatened species, feral and pest animals and commercially harvested native species, such as the kangaroo. Indeed, the history of kangaroo management provides an apposite example of how wildlife management evolved in Australia. The following section provides a brief history of kangaroo management from open access harvest for the skin market to the contemporary management regime of conservation through sustainable use. It also presents background to the kangaroo industry and commercial use of wildlife by Aboriginal people.

The management of kangaroos

History of kangaroo management

Landscape changes brought about by the expansion of livestock husbandry to the semi-arid and arid regions of the country favoured the large species of kangaroos (red kangaroo, *Macropus rufus*; eastern grey kangaroo, *M. giganteus*; western grey kangaroo, *M. fuliginosus*; and the euro, *M. robustus*). In particular, land clearing and the introduction of permanent water points in a previously dry landscape caused the populations of large kangaroos to increase. Control of the dingo (wild dog) reduced predation and acted as a catalyst causing kangaroo numbers to further increase (Newsome 1975; Young 1996). Kangaroos were competing with livestock for available feed and the response was to kill large numbers of kangaroos. From the 1870s to 1917 kangaroo remains earned a government paid bounty in most States. During this period the destruction of kangaroos was "actually required by legislation" (Poole 1984:3).

Poole (1984) and Kirkpatrick and Amos (1985) trace the evolution of kangaroo management. They state that a strong market for the skins of native animals had developed by the late 1800s. However, where harvest for skins declined for other native animals by the late 1920s, kangaroo skin, a strong yet supple leather, remained in demand. Some level of government protection was afforded to native wildlife in most States by the 1920s, but kangaroos were deemed a pest to agriculture and unrestricted harvest, in effect open-access, continued (Poole 1984).

Trade in kangaroo meat was slow until the dramatic reduction of rabbit numbers due to myxomatosis in the late 1950s (Poole 1984). The rabbit industry had supplied meat for decades and its decline meant that there were a large number of unused chiller boxes in southern inland Australia. Some rabbit industry operators adapted these chiller boxes for the previously unused meat of kangaroos, a strategy that "proved highly successful in commercial terms" (Kirkpatrick and Amos 1985:85). This innovation spread and the commercial kangaroo industry developed rapidly, mostly in the sale of pet meat. In the 1960s, nearly two-thirds of the kangaroo harvest was used to produce both leather and pet food (Kirkpatrick and Amos 1985).

The harvest of kangaroos and the industry that had developed went largely unregulated until the 1960s when public interest in kangaroo harvest emerged with concerns for the welfare and conservation of harvested kangaroo species. Public scrutiny led to a parliamentary inquiry into the harvest of kangaroos in 1971 (Poole 1984). It reported that populations were relatively stable and the kangaroo industry provided an important control on grazing pressure in the rangelands. However, it recommended the industry introduce harvest limits and keep records of harvest (Commonwealth of Australia 1971).

Further pressure from animal rights activists, including some dissent amongst conservationists, caused the Australian Government to ban export of kangaroo products in 1973. As a result the industry lost access to about 70% of its market and was left in disarray. Affected rural communities lobbied for the ban to be lifted or for governments to reintroduce vermin control legislation for kangaroos. The Australian Government responded by requesting that all States set annual quotas for kangaroo harvest and required that special tags be attached to all harvested kangaroos. In 1975 the Australian Government determined that risks to kangaroo populations from the previously unregulated industry were now under control and lifted the export ban (Kirkpatrick and Amos 1985). Over the past 30 years the kangaroo industry has recovered and developed into a significant industry.

The contemporary management regime for kangaroo harvest

Today, kangaroo management in Australia involves population monitoring, quota setting and regulated harvest. State government agencies administer kangaroo management programs which include commercial harvest in New South Wales, Queensland, South Australia, Western Australia and Tasmania. Their kangaroo management plans aim primarily to conserve kangaroo populations across their range and emphasise the sustainability of harvest. Secondary objectives may include minimising the deleterious effects of kangaroo grazing on production and conservation values (Pople and Grigg 1999).

Kangaroo management by State governments has a well-established record that demonstrates that the goals of commercial harvest are consistent with conservation of the harvested species (O'Brien 1990). Harvested populations are monitored by annual

aerial survey. The accuracy and validity of the survey methodology has been carefully scrutinised over the 30 years of its operation (see for example, Caughley and Grigg 1981; Bayliss and Giles 1985; Short and Bayliss 1985; Short and Hone 1985; Bayliss and Yeomans 1989; Pople et al. 1998; Tracey et al. 2005). Survey data show that kangaroo populations fluctuate with rainfall (Cairns and Grigg 1993) and that the regulated harvest of kangaroos is ecologically sustainable in the long term (Grigg 2002).

The kangaroo industry directly employs about 4,000 people nationally. It is economically valuable to rangelands communities and makes some contribution to the national economy. Over the past 20 years the kangaroo industry has experienced 7% average annual growth in productivity (Kelly 2005). Exports have been rising steadily since the late 1980s and are a major contributor to this growth (Hercock and Tonts 2004). Kangaroo products are now exported to over 60 countries. Meat exports to European markets generated over A$20m in 2004. The annual value of the industry to the Australian economy was estimated at A$200m in 2005 (Commonwealth of Australia 2005; Kelly 2005).

At the national level kangaroo products are gradually becoming more widely accepted. South Australia has the highest level of consumer acceptance of kangaroo meat for human consumption compared to other States (Purtell and Associates 1997). This is due to the use of kangaroo meat for human consumption having been legalised in South Australia in 1980 much earlier than other States. Other States followed in 1993 (Pople and Grigg 1999). Kangaroos in South Australia are harvested in accordance with hygiene standards established for human consumption. This is also the case in other States with the exception of Queensland where kangaroos are harvested for human consumption, skin-only or both markets.

The kangaroo supply chain is critical to maintaining and expanding these domestic and international markets. The industry experiences variability in supply that creates some instability in the supply chain. Supply of kangaroo carcasses varies according to fluctuations in weather conditions which impact on kangaroo abundance and the ability of harvesters to access kangaroo populations. This is problematic given the

increasing expectation of consumers in a global market place that supply will meet their demands rapidly and accurately (see for example, Webster 2002).

Figure 2 shows the kangaroo product supply chain from producers to wholesalers, distributors, retailers and consumers. This research is focused on the producers and wholesalers in the supply chain. Table 2 outlines the roles these people and companies have in the industry. As indicated in Table 2, staff of State and Australian government agencies are also involved in the industry in monitoring kangaroo populations and administering regulations that govern commercial harvest and meat processing.

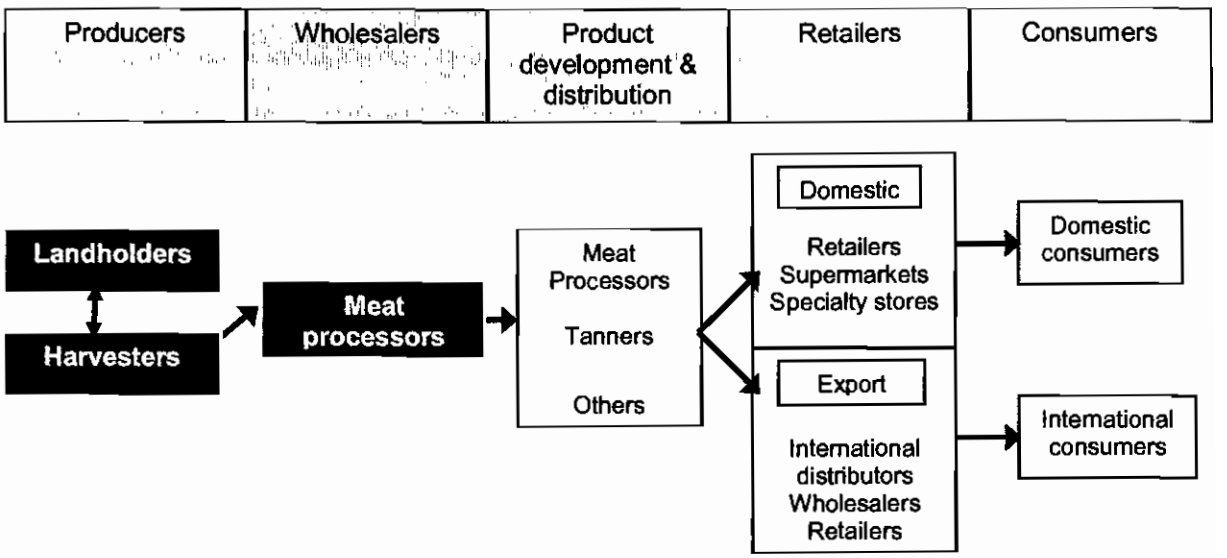


Figure 2: The kangaroo industry supply chain

Table 2: People's roles in the kangaroo industry

Who?	Role in the kangaroo industry
Landholders	Provide habitat that maintains high kangaroo populations
Harvesters (field processors)	Shoot and dress kangaroo carcasses in the field with permission of landholders
Meat processors	Process carcasses supplied by harvesters Distribute meat to wholesalers Supply skins to tanneries Market and distribute meat products to wholesalers, retailers and consumers
Skin tanners	Process, supply and market skins to leather and leather products
State and Australian government agencies	Monitor kangaroo populations Regulate and administer commercial harvest and meat processing

Kangaroos and total grazing pressure

Most kangaroos are harvested on pastoral rangelands, that is the 58% of Australian rangelands where livestock grazing is the main extensive land use (AG DAFF 2005). The dominant form of land tenure in the rangelands is pastoral lease. The major land use on pastoral leases is the grazing of livestock, primarily sheep and cattle (Productivity Commission 2002). This form of land use has led to widespread degradation (Musgrave 1983; Noble et al. 1984). Land degradation generally involves a decline in palatable vegetation and soil condition (Norbury and Norbury 1993). Although land degradation is difficult to estimate, over half of the pastoral rangelands are assessed to be experiencing degradation to some extent (Norbury and Norbury 1993; Heathcote 1994). Ludwig and Tongway (1995) have estimated that about 26% of Australia's rangelands are suffering severe degradation and 16% are in a very severe state of degradation.

Management of total grazing pressure is the main tool available to address land degradation on pastoral lands. Total grazing pressure (TGP) refers to the combined impacts of herbivorous mammals on vegetation (Choquenot et al. 1998). Two components of TGP are recognised: domestic livestock and wild stock, both feral and native. Managing the livestock component of TGP is achieved through conservative stocking rates, spatial distribution of water points and the movement of livestock

between paddocks. Managing the wild stock component presents a challenge that is usually addressed by reducing populations through culling or commercial harvest (Fisher et al. 2004).

Management of TGP is important to maintaining resilience of rangeland ecosystems as it provides the ecosystem and the social system it is linked to with resilience to ecological shocks (Scheffer et al. 2001; Stafford Smith and Reynolds 2002; Gunderson 2002). The unpredictability of rainfall – its timing and magnitude – is a substantial source of ecological shock in South Australian rangelands. The irregular cycle of drought and flood that results, leads to these rangelands being characterised as 'boom and bust' environments. While this cycle is inherently unpredictable, continual attention to TGP allows managers to guard against 'slower' changes in soil structure and vegetation. Attending to these 'slow' variables supports the capacity of the ecosystem to persist in drought, to 'boom' after heavy rain and to maintain its overall productivity through these cycles.

Kangaroos make a significant contribution to total grazing pressure in arid rangelands (Freudenberger and Hacker 1995; McLeod 2004). When kangaroo populations are overabundant they can have severe deleterious effects on native vegetation (Fisher et al. 2005). Shepherd and Caughley (1987) argue that kangaroo abundance has increased over the past 120 years to a level that may be affecting the composition and biomass of native vegetation.

A number of studies have examined the impact of kangaroo grazing on native vegetation regeneration in arid and semi-arid rangelands (see for example, Gardiner 1986; Norbury and Norbury 1993; Sluiter et al. 1999). Results show that sites protected from livestock and kangaroo grazing pressure contain greater species diversity and vegetative biomass than sites where livestock is excluded but where kangaroo grazing occurs. Page and Beeton's (2000) grazing trials in the mulga lands of south-west Queensland confirmed previous findings by showing that kangaroo grazing pressure limits regeneration of native grasses in areas excluded from livestock grazing.

The effect of competition between livestock and kangaroos on pastoral production values has also been studied extensively. There is broad consensus that there is a degree of dietary overlap between kangaroos and domestic livestock that is most prominent during drought conditions (see for example, Wilson 1991a; Dawson and Ellis 1996; Edwards et al. 1996). There is also general agreement that kangaroo grazing is often concentrated in paddocks that are being rested from use by livestock (Andrew and Lange 1986; Wilson 1991b; Edwards et al. 1996). Wilson (1991b) concluded that kangaroo grazing has deleterious impacts on wool production in sheep grazing country. Edwards et al. (1996) found no detectable effect on wool production but noted that sheep in competition with kangaroos recorded lower live weights than those in paddocks protected from kangaroo grazing pressure. Overall, the contribution of kangaroo grazing to total grazing pressure in Australia's rangelands provides a strong case for intervention that manages kangaroo abundance.

Sustainable use, conservation and economic value

Conservation of wildlife through sustainable use is a concept based on creating economic incentive for landholders to retain and protect native habitats and species (Ramsay 1994; Webb 1997; Commonwealth of Australia 1998). The aim is to generate conservation benefits by increasing the economic productivity of native habitats and encouraging landholders to rehabilitate degraded habitats (Jenkins 1995). Conservation through sustainable use of wildlife contributes to ecologically sustainable land management by diversifying agricultural production. It is now widely accepted that sustainable agricultural practices are best achieved through a range of management modes rather than dependence on single species or land management functions (see for example, Berkes et al. 1991; Cock 1992; Coop and Brunckhorst 1999).

Commercial harvest of kangaroos has long been proposed as an opportunity for landholders in Australian rangelands to realise value from wildlife. Gordon Grigg of the University of Queensland has been the most prominent advocate. Grigg (1987) argued that overgrazing by domestic stock has proved detrimental to the long-term ecological health of the rangelands. He encouraged landholders to value and commercially exploit the kangaroo as 'sheep replacement therapy for rangelands'. He has argued that significant financial returns for landholders from commercial harvest

of kangaroos will lead to landholders putting more emphasis on providing suitable habitat for kangaroos, reducing sheep stocking rates and generating benefits for land condition (Grigg 2002).

Grigg (2002) argues that the low retail price of kangaroo meat is the greatest hurdle to the implementation of his proposal. Young and Wilson (1995) predicted that landholders will be able to realise financial returns from kangaroos when kangaroo meat is comparable in price to other red meats. Australian retail prices for prime cuts of kangaroo are often now quite comparable to those for good cuts of beef or lamb. However, up to 70 per cent of kangaroo meat is used for pet food at much lower prices (Grigg 2002; Kelly 2005). The Kangaroo Industry Association of Australia (KIAA) argues that a shift to majority human consumption is needed to rectify the overall low market value of kangaroo (Kelly 2003). Momentum is gaining, with media attention in recent years to the health benefits of eating kangaroo meat highlighting its leanness, high levels of protein, iron, zinc and healthy fats when compared with other red meats (Domico 2000; CSIRO 2004). A further impetus is the growing interest in Australia in native or bush foods. Niche markets in Australia for kangaroo are growing, although, kangaroo products remain underpriced on global markets in comparison with beef and lamb (Hercock and Tonts 2004).

As discussed earlier in this chapter (see page 14) private property rights in wildlife have not been established in Australia. This lack of property rights causes reluctance amongst landholders to embrace kangaroo harvest as an alternative or supplementary management option to traditional livestock grazing (as discussed in Article 4). Grigg (1995) has given some consideration to the issue of property rights in kangaroos. He acknowledged that some conservation groups are opposed to ownership of wildlife being transferred to individuals and that landholders are reluctant to base a significant portion of their earning capacity on a wild animal that they do not own (see also Chapman 2003). Grigg (1991; 1995) proposed that the government requirement that all commercially harvested kangaroos are marked with designated numbered tags could address both concerns. These tags are markers that establish that kangaroos are legally harvested. Grigg proposed that harvest quotas and tags be allocated to individual landholders based on the localised population density on their properties. Landholders could then either employ kangaroo harvesters, sell their tags to

harvesters, or enter into contractual arrangements with harvesters or meat processors. Through their control of the tags landholders would realise a right to financial return from selling kangaroos off their property, but only up to the predetermined quota limit.

South Australia revamped its kangaroo management program in the mid 1990s. From 1996 it began to allocate the quota to property level along the lines that Grigg (1991; 1995) advocated. Other measures were also introduced in South Australia in the same period to expand opportunities for sustainable commercial use of wildlife, notably regulations to provide for emu farming. This was part of the growing interest in wildlife conservation through sustainable use that has led some other States to explore small scale opportunities for commercial harvest of other species, such as crocodile and reptiles (Grigg et al. 1995; Commonwealth of Australia 1998). This emerging national interest in conservation through sustainable use of wildlife led to South Australia embracing the idea that landholders could realise value from kangaroos through the allocation of harvest quota to individual properties. This experiment has resulted in perverse outcomes that are explained in Articles 2 and 3 (Chapters 5 and 6). Recently, the Future of Australia's Threatened Ecosystems (FATE) Program has been developing collaborative management regimes amongst landholder groups in New South Wales (Ampt and Baumber 2006). The FATE Program has the advantage of learning from the South Australian experience, and this research, and has great potential to establish a program for conservation through sustainable use of wildlife.

Aboriginal people and commercial use of wildlife

Aboriginal commercial use of native animal species is currently best established in Arnhem Land Aboriginal communities where it is part of a strategy for economic development that supports 'caring for country'. Bawinanga Aboriginal Corporation has the most diverse and innovative suite of activities including crocodile egg harvesting, turtle hatchlings, goanna and native fish with active involvement of scientists and local people in addressing sustainable use (Altman and Whitehead 2003; Cochrane 2005). Trophy hunting for crocodiles has also been proposed in this region, but failed to achieve Australian Government approval in 2006.

Few Aboriginal people are involved in the commercial kangaroo industry. In South Australia, seven pastoral leases in the commercial harvest zone are owned by Aboriginal family based corporations and may engage in commercial harvest in the same way as other pastoral leaseholders. Only one Aboriginal person has held a permit for commercial kangaroo harvesting in recent years. Other States have similarly low levels of Aboriginal involvement in the kangaroo industry.

Involvement in commercial wildlife industries has been advocated as a pathway for Aboriginal economic development and sustainable resource use (Coombs et al. 1990; Wilson et al. 1990; Williams et al. 1995; Altman et al. 1996; Bomford and Caughley 1996; ATSIC and DPIE 1997; Davies et al. 1999). However, most indigenous enterprises based on commercial use of wild animals have struggled to achieve viability as a result of short term and discontinuous support for capacity building, poorly developed supply chains and markets, and remoteness of many harvesting activities from processing facilities. The Australian Government's Aboriginal Rural Resources Initiative (ARRI) program, which operated from 1992 to 1995 and had antecedents in the Aboriginal Contract Employment Scheme established in 1988, supported projects for indigenous people to generate employment and income through the use of wild animal resources such as kangaroos and various feral species. There was high demand from Aboriginal people for support from the ARRI program (Williams et al. 1995). There has been no specific government support for indigenous wildlife enterprise development since 1996.

Two ARRI projects supported Aboriginal people to develop enterprises based on harvesting kangaroos, one in the Charleville region of Queensland and one in Esperance, Western Australia. In both cases the Aboriginal people involved had previous experience as kangaroo harvesters. In 1995 the Esperance project was operating as a commercially viable business and the status of the Charleville project was uncertain (Williams et al. 1995).

Strong demand experienced by the ARRI program from Aboriginal people interested in establishing enterprises based on feral animals reflects Aboriginal people's view that feral species have economic value. This view comes from Aboriginal people's own use of some species for food, notably rabbits and buffalo, and their observation

of and periodic participation in commercial harvesting of goats, camels, rabbits and buffalo (see for example Altman 1982; IAD 1994; Bowman and Robinson 2002). This is one reason for widely documented disquiet from indigenous people about culling any animals without use of the meat. Cultural significance of animals, including some feral animals (Nugent 1988; Rose 1995; CLC 2005) also leads Aboriginal people to object to 'shooting to waste', rather than using animals.

Because of these Aboriginal values, culling of animals has been a particular trigger for periodic conflict between Aboriginal people and others about management of wildlife, both native and feral species (Kean et al. 1988). Such conflicts are difficult to resolve unless Aboriginal people have been part of the decision-making process (Rose 1995). Where Aboriginal people have observed and considered the land degradation resulting from high populations of grazing animals they tend to be more willing to control wild populations by culling, especially where there are opportunities for them to access resources to implement control programs. For example, in the Nantawarrina Indigenous Protected Area (IPA) in the Flinders Ranges, Adnyamathanha people used to periodically muster and sell feral goats prior to their decision to manage the area for conservation in 1998. Implementation of this decision, supported by resources through the Natural Heritage Trust IPA program, has led them to focus on culling, rather than harvesting, feral animals and is assisting in vegetation recovery (Chester and Last 2002).

There has been very limited Aboriginal involvement in government decisions about management of wildlife or their commercial use (Davies et al. 1999; Altman and Cochrane 2003). Queensland was the first State to give attention to considering Aboriginal perspectives in kangaroo management. An Aboriginal community representative was involved in the statutory Macropod Management Advisory Committee in the 1990s (Fourmile 1996). The South Australian Department for Environment and Heritage began to address Aboriginal interests in kangaroo management in 2002 for the first time. It invited the SA Aboriginal Legal Rights Movement Inc, as the representative body for native title holders and claimant groups under the *Native Title Act* 1993 [Commonwealth], to participate in the review task group for its kangaroo management plan.

National expenditure on projects and policy development to more effectively involve indigenous people in Australian natural resource management has markedly increased since the 1990s when the important role that indigenous people and their knowledge can play in understanding ecosystems was first formally recognised in Australian policy (see Commonwealth of Australia 1996). Involvement of Aboriginal people and attention to their interests in natural resource management continues to be spatially patchy and arguably inequitable (Lane and Corbett 2005; Williams 2005; Worth 2005). However, the inclusion in 2005 of a new objective of promoting indigenous community participation amongst the seven high level national objectives for regional natural resource management investment (AG NRM 2005) highlights the commitment by Australian governments to continue to address this issue (and see Commonwealth of Australia 2004).

Research problem, aim and objectives

Kangaroo management is a 'wicked' problem to which there is no simple policy solution. Faced with reconciling the interests of pastoralists, meat processors, harvesters and the public, government policy seeks primarily to conserve kangaroos across their natural range while managing adverse impacts of high kangaroo numbers through commercial harvest. However, the commercial harvest of kangaroos causes emotions to run high in a section of the Australian and international community. To some people the commercial harvest of a wild animal to meet human needs is unacceptable. Protests against kangaroo harvest have been staged in Australia, the United Kingdom and other countries (Donnan 2002). Minority groups opposed to commercial kangaroo harvest have been vocal and use the internet to deliver their message (Winter 2002). The result of organised action against the commercial harvest of kangaroos has been the development of an industry that mostly avoids self-promotion. Furthermore, both industry and government have tended to focus research attention on proving the biological sustainability of the harvest. Therefore, the biology, ecology and population dynamics of harvested kangaroo species are well understood and sustainability of harvests over a long period is well-documented.

At a broader level, the intent of kangaroo management systems to demonstrate sustainability is questionable while they do not account for the rights and interests of Aboriginal people (Davies et al. 1999). Kangaroos hold subsistence, cultural, social

and economic value for Aboriginal people. Potentially there are opportunities for the kangaroo industry to engage with outstanding issues of Aboriginal rights and interests in kangaroos because of rising interest from consumers in products that can demonstrate they are 'traded fairly' (WRI 2002; Hargroves and Smith 2005). Consumers are increasingly interested in "the world behind the product they buy...how, where and by whom the product has been produced" (Topfer, UNEP in Hargroves and Smith 2005: 123). In their review of business opportunities and innovation for the 21st Century, Hargroves and Smith (2005) conclude that there is a strong business case for the move by innovative companies to certify their products and services using ecological and fair trade labelling schemes.

Aboriginal people and other parties have been negotiating all kinds of agreements for mutual benefit, particularly since the High Court Mabo decision (see ATNS Data Base 2002). Why not consider the prospect for agreements that provide for kangaroo products to be endorsed by Aboriginal traditional owners of the land where kangaroos are harvested? Perhaps this could provide market appeal that would help balance periodic vocal opposition to kangaroo harvest from animal liberation and vegetarian lobbyists?

Questions such as this are hard to approach without understanding the social, institutional and economic issues that kangaroo management presents for people in the industry and the issues that the commercial harvest of kangaroos presents for Aboriginal people. As past research concentrated on questions of ecology and biology, the need to advance understanding of the social issues in kangaroo management provided the impetus for this research. Thus, the aim of the research is:

To apply understanding of social and institutional factors in order to improve the management of kangaroo harvest in South Australia,

and the specific objectives of the research are:

- to explore the reasons for low harvest rate in South Australia
- to analyse the institutional settings for kangaroo harvest in South Australia
- to examine stakeholder perspectives and interests in kangaroo management

- to develop an understanding of Aboriginal people's interests in, and perspectives on, kangaroo management and harvest.

This thesis presents detailed research targeted towards the above aim and objectives. The next chapter outlines the research methodology and considers the validity of this research. The subsequent chapters present five peer-reviewed papers and the comparative study of kangaroo and moose harvest that provides an overarching discussion bringing together the main features of the papers.

Chapter 3

Methodology

NOTE: This image is included on page 41 of the print copy of the thesis held in the University of Adelaide Library.

An interview with kangaroo harvesters near Lyndhurst, far north South Australia, July 2003.

Introduction

Wildlife management invariably involves a search for balance amongst the different motivations, experiences and viewpoints of people with a stake or interest. Qualitative methods provide a view of the social world from the viewpoints of different people (Bryman 1984) and in this way are useful for examining issues in wildlife management.

The nature of knowledge within qualitative scientific inquiry is different from knowledge in quantitative inquiry. The choice of qualitative or quantitative methods is one of meaning versus measurement and depth versus breadth. In short, qualitative methods provide detailed meaning and depth of understanding whereas quantitative methods lead to a measured and broad understanding of a phenomenon (Patton 1990).

Being aware of the different forms of understanding that qualitative and quantitative methods produce is important to selecting the method of inquiry that best fits the research problem (Morgan and Smircich 1980; Bryman 1984; Holloway and Todres 2003; Patton and Appelbaum 2003; Flyvbjerg 2006). Gerring (2004:348) observes that "research designs invariably face a choice between knowing more about less and knowing less about more". Quantitative research generally gathers a small amount of information from a very large sample. In social research the questionnaire is a good example of this. In contrast, qualitative research gathers a great deal of rich and detailed information from a small sample (Gerring 2004).

As described in Chapter 1, the aim of this research is to apply understanding of social and institutional factors in order to improve the management of kangaroo harvest in South Australia. This requires a detailed understanding of kangaroo management. Therefore this research sought to 'know more about less'. This chapter of the thesis presents the methodology that underpins this research and examines the validity of the research using qualitative evaluation criteria. The research methods used in this study are described in the articles presented in Chapters 4 to 8.

A philosophical framework: finding the appropriate paradigm

This section of the chapter briefly overviews the scientific paradigms that could have potentially framed this research: positivism, constructivism, critical theory and realism. Realism is presented as the most suitable paradigm for this research. Greater concern was placed on selecting a methodology and methods that fit the research problem than on considering the philosophical basis of the research approach. Thus, the philosophical framework that underpins this research is not a topic that is dwelt upon at length. The focus on appropriate methods rather than philosophical standpoint has support from other qualitative researchers. Reid (2002) argues that epistemology (the study of knowledge) is not essential to the practice of research. He states, "questions about 'what is truth?' are of less concern to the researcher than questions about what is true in particular circumstances" (Reid 2002:291). In the same vein Seale (2002:99) expresses his position as: "In my view, research is primarily a craft skill, relatively autonomous from philosophical and theoretical considerations but drawing on these debates at times to feed creativity or loosen trapped thoughts".

Four paradigms: positivism, constructivism, critical theory and realism

Social research can be framed using a number of scientific paradigms. A paradigm, as defined by Kuhn (1962), is a set of basic principles that defines the nature of the world, or a 'world view', that is shared by a community of scientists. Within social science there are four main paradigms: positivism, constructivism, critical theory and realism (Guba and Lincoln 1994). Each paradigm consists of three basic components: ontology, epistemology and methodology (Yeung 1997). Ontology is the study of the concept of reality, epistemology is the study of knowledge and methodology is the technique employed by a researcher to gather knowledge within that reality (Healy and Perry 2000). Table 3 provides an overview of the main paradigms of social inquiry and their components.

Table 3: Framework for categorising four different scientific paradigms

Axiom	Paradigm			
	Positivism	Constructivism	Critical theory	Realism
Ontology	Reality is discernable and reducible	Reality is constructed	Reality shaped by social, political, cultural and other factors	Reality is discernable but only an imperfect picture is possible
Epistemology	Objective Findings are true Value-free	Subjective Findings are constructed Value-laden	Subjective Findings dependent on social/historical patterns Value-dependent	Elements of objectivity and subjectivity Findings are probably true Value-aware
Methodology	Empirical Deductive	Interpretive Inductive	Dialectical Inductive	Understanding and explanation; Both inductive and deductive

Source: Adapted from Lincoln and Guba (1985); Guba and Lincoln (1994); Perry (1998) and Houston (2001).

Positivism is the dominant paradigm of natural science that assumes independent facts can be quantitatively measured within a single reality (Tsoukas 1989; Guba and Lincoln 1994; Healy and Perry 2000). Data and analysis within the positivist paradigm are value-free and generate a form of knowledge that resembles a "concrete structure and precise facts" about phenomenon (Parkhe 1993:237). In social science the positivist view is that research participants are independent and non-cognitional, a view that ignores their ability to consider and act on problems (Healy and Perry 2000). Guba and Lincoln (1994:110) describe the process as viewing the social world through a "one-way mirror" because there is assumed to be no change in the observed reality as a result of the act of observation. Thus, the epistemological basis of positivism is objectivity and the ontological basis is that reality is discernable. These characteristics of positivism make this paradigm useful for social research where the questions being asked relate to some form of measurement, such as 'how many?' or 'how often?' rather than questions of quality such as 'how do?' or 'what effect?'. For this reason positivism is an inappropriate paradigm for researching the management of wildlife which involves people and real-life experience. When an understanding of 'how do?' problems is sought the other three paradigms provide more suitable frameworks.

In contrast to the positivist paradigm's focus on quantitative measurement, the next three paradigms, of constructivism, critical theory and realism, employ predominantly qualitative research methods. Constructivism rejects the notion of an objective truth (Hunt 2005). Rather, truth is dependent on individual people or groups who hold that perspective (Guba and Lincoln 1994), and as such it is a fabrication of reality relative to social context (Johnston et al. 2000). Thus, constructivists operate in the value-laden, subjective world where multiple realities exist in people's minds (Healy and Perry 2000). The constructivist paradigm is most suited to understanding questions of culture, religion or prejudice (Johnston et al. 2000) but less appropriate for examining the 'real' economic and technological aspects of wildlife management.

Critical theory assumes that reality consists of "historically situated structures" (Guba and Lincoln 1994:111). It investigates social realities incorporating various values such as political, cultural, economic, gender or ethnic. For critical theorists knowledge is grounded in social and historical patterns (Guba and Lincoln 1994). Furthermore, critical theory is value-laden where it is assumed that the values of the researcher inevitably influence research outcomes (Healy and Perry 2000). Thus, critical theory is most usefully applied when the researcher aims to critique and transform particular social processes, such as gender discrimination (Crotty 1998). The 'historically situated' and value-laden nature of critical theory makes the paradigm unsuitable for this research. As a researcher studying wildlife management I was not expecting to influence outcomes or transform the process, it was instead, my intention to collect observable facts about a social phenomenon.

The third qualitative paradigm considered here, realism, was found to fit this research problem. Realism, as a philosophy useful to those engaging in social research, was first proposed by Bhaskar (1975) and has since been adapted and modified by many other authors (Outhwaite 1987; Layder 1990; Sayer 1992; Collier 1994; Mantysaari 2005). Many different versions of realism are present in social sciences and some are contradictory (Miles and Huberman 1984; Yeung 1997; Mantysaari 2005). However the debate between various forms of realism is best left to philosophers. As Miles and Huberman (1984:21) argue social researchers will better spend their time getting on with their work rather than engaging in "paradigmatic disputation". Thus, the purpose

here is to describe the elements of realism that made it a suitable choice as a paradigm to frame this research.

Realism contains elements of both positivism and constructivism (Hunt 2005). In the constructivist tradition, realism accepts that unseen social structures both influence, and are influenced by, human action. Even though social 'facts' are elusive the realist follows the positivist position that valid knowledge is attainable albeit within a particular social context (Lawson and Staeheli 1990; Healy and Perry 2000). Generally the realist view is that "there is a reality out there independent of our thoughts and actions" (Houston 2001:850). In contrast to critical theory and constructivism where a participant's views are being sought for their own sake, in realist research the perspectives of the individual are sought to develop an understanding of a reality beyond those perspectives (Healy and Perry 2000).

Realism is neither value-free (positivist) nor value-laden (critical theorist and constructivist). Instead researchers in the realism paradigm are aware of values. The realist view is that social phenomena can be understood but the understanding is likely to be imperfect (Healy and Perry 2000; Sayer 2000). Perry (1998) describes realism as descriptive rather than prescriptive in that it seeks to answer 'how do' questions rather than 'how should' questions. He argues that realism is the most fitting paradigm for case study approaches to social research. The fundamental aspects of realism including the blend of positivism and constructivism, value awareness and a focus on understanding and explanation made realism an appropriate paradigmatic framework for this research. Thus, it is the paradigm that best fits the problem of wildlife management and this research.

The research approach

A number of research approaches can be applied within the realism paradigm (Guba and Lincoln 1994) such as process evaluation and action research. But most commonly methods employed in the realism paradigm include case studies and interviewing (Christie et al. 2000). For this research, the best fitting approach was found to be case study including semi-structured interviews for primary data collection, some participant observation and specific methods derived from grounded theory in data analysis. This approach drew on ethnographic methodology.

Ethnographic methodology

The goal of ethnography is to "describe, interpret and understand the characteristics of a particular social setting with all its cultural diversity and multiplicity of voices" (Holloway and Todres 2003:348). Ethnography has its origins in cultural anthropology but it has moved on from a focus on 'culture' to "people's perspectives on society and their positions within it" and is now also applied to a range of disciplines (Holloway and Todres 2003:353). For example, ethnographic field work may focus on a particular organisation, the interactions of the people within it and how people's relationships with one another are linked to the social or cultural context of the organisation (Patton 1990). The research problem of exploring kangaroo management required just such an approach.

A particular aspect of ethnography, the close association between researcher and research participants, was important to this research. With a goal of developing deep understanding, ethnography provided the rich data that is produced when the researcher can get "close to his subjects and so see the world from their perspective" (Bryman 1984:78). Thus, a defining feature of ethnographic research is an intensive fieldwork component (Johnston et al. 2000; Holloway and Todres 2003). Traditionally, intensive ethnographic fieldwork involves the researcher becoming completely immersed in the field situation by living amongst the interest group for a period of one to three years. However, contemporary ethnography practice utilises different time modes dependent on the study site. This research employed selective intermittent ethnographic method which offers a flexible approach to the timing and duration of site visits. In this ethnographic approach, the topics of investigation are identified and actual time spent in the field is determined by the level of information 'saturation' (Jeffrey and Troman 2004).

Other important features of ethnographic research methods are described by Holloway and Todres (2003) and include:

- a goal to uncover the structures and interactions within a society, organisation or other collective of people
- the research is organised around the research participants' experiences, relationships and behaviour

- data collection is approached without steadfast prior assumptions and the views of the researcher are not imposed on research participants
- data analysis follows specific procedures but the development of classifications or categories are dependent on the individual researcher
- ethnography produces theories that can be applied in other situations.

In conducting this research, I was interested to understand the management of commercial kangaroo harvest in terms of how the management system operates and the interactions of the people involved. Therefore, the focus of ethnographic methods on detailing the experiences of research participants through intensive field work was found to fit with the research problem. While selective intermittent ethnographic method guided the overall research approach, specific methods were selected for data collection and analysis.

Use of the case study

The detail of the case study areas used in this research is presented in the articles that appear as Chapters 4 to 8. My purpose here is not to repeat the information already provided, but to explain why the case study was an appropriate method. The case study is most useful to research that seeks to answer 'how' and 'why' questions and where the focus of the study is a real-life contemporary problem (Yin 1989; Patton and Appelbaum 2003). Furthermore, a case study is appropriate when the research approach calls for in-depth detail and the research problem involves a range of factors. As Gerring (2004) has noted, an advantage of the case study is the depth of understanding that is possible. In this research, I was certainly seeking depth of understanding. The purpose of the research was to develop a descriptive, detailed understanding of the management of commercial kangaroo harvest – a real-life phenomenon in a contemporary context. Thus, the case study approach using semi-structured in depth interviews was selected as a most appropriate data collection approach for this research.

The case study employed in this research uses information gathered in three case study regions across South Australia. The case study regions are described in the methods sections of Articles 2 to 4 (Chapters 5 to 7). It is important to note that the case study regions are not separate case studies. Rather, qualitative and quantitative

data collected in these regions was collated and analysed in order to describe the social and institutional dimensions of kangaroo harvest in South Australia.

Grounded theory methods

Although the methodology employed in this research is ethnography, certain methods of grounded theory were used. This is not an uncommon practice. As Holloway and Todres (2003) state, specific grounded theory methods are often applied in other qualitative methodologies. Specifically, grounded theory methods were employed during the process of data analysis. As common in grounded theory, I approached data analysis without strong preconceived ideas (Charmanz 2006). Grounded theory methods also call for the data to be studied carefully and then for the researcher to take a step back from the data to allow concepts and patterns to emerge (Glaser and Strauss 1967). Thus, I studied the data carefully, going over transcripts a number of times before I coded particular sections of the fully transcribed interview texts under different categories. According to Charmanz (2006:45) "grounded theory coding generates the bones of your analysis...coding is more than a beginning; it shapes an analytical frame from which you build the analysis". In this way I used grounded theory methods of looking at, and then coding, the data to develop, explore and analyse the major findings of the research.

Although this research process follows established methodologies, it is necessary to ask the question: is this research a valid representation of the phenomenon under scrutiny? Qualitative methods have been subject to intense criticism (Demeritt and Dyer 2002; Dovers 2005). For example, Patton and Appelbaum (2003:65) state that the "harshest criticisms of the case-study approach have revolved around the question of validity. Specifically case studies are accused of being subjective, lacking rigour and yielding findings that cannot be generalised across settings". Similar criticisms have been levelled at other qualitative research methods (see for example, Openshaw 1998). In response, researchers of the social sciences have developed criteria for evaluating qualitative research that address such criticism of qualitative methods (Schwandt 1996). The purpose of the following section is to specifically engage with the issue of validity in this research process by applying criteria for evaluation of qualitative research.

Demonstrating validity: evaluating qualitative research

Validity is defined here as the reliability of scientific inquiry. There are many different ways to assess validity in qualitative research. Golafshani (2003:602) states that "some qualitative researchers have argued that the term validity is not applicable to qualitative research" but many others are concerned about the issue of validity (see for example, Crawford et al. 2000; Madill et al. 2000; Hall and Callery 2001; Riege 2003; Russell and Gregory 2003; Lietz et al. 2006). Indeed whether the research is quantitative or qualitative there is a need for measures with which to judge the quality of the work (Lietz et al. 2006).

Schwandt (1996) uses the curious term 'criteriology' to describe the practice of establishing and defining criteria suitable to judge the quality of qualitative research. An examination of the literature concerning the 'quality' of qualitative research revealed many authors describing different criteria for measuring validity. There was little consistency in how validity should be assessed and much confusion in the terminology used. For example, what is described as 'credibility' by some authors (Lincoln and Guba 1985; Patton 1990) is termed 'construct validity' by another (Yin 1989) and 'theoretical sensitivity' by yet another (Hall and Callery 2001). In order to evaluate this research it was important to work through this confusion and answer the question: 'what criteria can most usefully be applied to the evaluation of this research?'

The multifarious criteria for evaluating qualitative research range from the description of particular strategies or methods (Patton 1999; Hall and Callery 2001; Macbeth 2001) to describing a range of criteria in detail (Healy and Perry 2000; Seale 2002). For this research a modified version of the evaluation criteria that is applied to quantitative studies was used. This approach to evaluating qualitative research is recommended by a number of authors (Lincoln and Guba 1985; Yin 1989; Denzin and Lincoln 1994; Baxter and Eyles 1997) and proved the most logical approach for two reasons. Firstly, the quantitative criteria of 'internal validity', 'external validity', 'reliability' and 'objectivity' are well-defined and have been in use for a long time. Secondly, modified versions of these criteria (namely credibility, transferability, dependability and confirmability) have successfully been applied to qualitative studies

(see for example Crawford et al. 2000; Jakobsen and McLaughlin 2004). The quantitative criteria and corresponding qualitative criteria are shown in Table 4, below.

Table 4: Quantitative and qualitative criteria for evaluating research

Research approach	Criteria for evaluating the quality (or rigour) of the research			
Quantitative	Internal validity	External validity	Reliability	Objectivity
Qualitative	Credibility	Transferability	Dependability	Confirmability

Source: Lincoln and Guba (1985).

The four criteria for evaluating qualitative research have been applied to this research process to consider the validity of this work. The entire research process is presented in Table 5 and each activity is assessed against each of the evaluative criteria. Ticks in a column indicate that an activity has met that criterion. Table 5 was constructed by documenting the activities that occurred at each stage of the research process. Decisions as to where to place the 'ticks' against criteria in the right hand columns were made with reference to a number of key texts that discuss these criteria and the methods and activities that enhance or strengthen each of them (primarily Lincoln and Guba 1985; Baxter and Eyles 1997, but also Patton 1990; Perry 1998; Seale 2002; Holloway and Todres 2003; Lietz et al. 2006). Discussion of each evaluation criterion drawing on specific examples of methods or activities used in this research (as shown in Table 5) follows.

Table 5: Research methods/activities and validity criteria

Stage of the research	Research method/activity	Credibility	Transferability	Dependability	Confirmability
Research Design	Multi-dimensional case study		✓		
	Purposeful sampling	✓			
Preliminary study	Literature review	✓			
	Preliminary interviews	✓			
Data collection	Engagement and saturation	✓			
	Semi-structured, in depth interviews following the interview question guide	✓		✓	
	Developing mutual trust between researcher and research participants	✓			✓
	Field notes kept as a log of field activities and as a reflective exercise for researcher				✓
	Triangulation of methods	✓			
Data analysis	Verbatim interview transcription	✓		✓	
	Use of qualitative data analysis software (NVivo) to assist data management			✓	
	NVivo database contains all coded interview transcripts				✓
	Grounded theory methods of coding and uncovering patterns in the data			✓	
	Folder titled 'Findings notes' kept as part of an audit trail				✓
	Quantitative summaries prepared and kept with 'Findings notes'				✓
Member checking	Return to research participants with main findings for exchange of ideas	✓			
	Discuss findings with people identified as industry experts	✓			
	Verify and clarify findings with industry regulators from SA and interstate	✓			
Write up	Use of quotes in the production of written material	✓			
	Formal products of the research including reports and papers published in peer reviewed journals				✓
	Discussion chapter of thesis a comparative study		✓		
Throughout the research process	Reflexivity – reflection on researcher-participant ineractions				✓
	Supervision by panel of academics	✓		✓	✓
	Peer debriefing	✓			

Credibility

In the positivist, quantitative tradition internal validity is the "extent to which variations in an outcome (dependent) variable can be attributed to controlled variation in an independent variable" (Lincoln and Guba 1985:290). The analogous term in qualitative research is 'credibility' which refers to the ability of the findings to make sense to the people involved and to be understood by those outside the experience (Lincoln and Guba 1985; Baxter and Eyles 1997). Baxter and Eyles (1997:512) state that credibility is the "most important principle for guiding qualitative studies". Credibility is enhanced in a variety of ways, including through the use of purposeful sampling, prolonged engagement, member checking, peer debriefing, verbatim interview transcription and quotes from research participants in the presentation of findings (Lincoln and Guba 1985; Baxter and Eyles 1997) Each is discussed in turn, below.

Purposeful sampling

A distinct and defining difference between quantitative and qualitative research is the approach to sampling. Quantitative methods utilise large, randomly selected samples in order to select a representative sample that allows confident generalisations to be drawn. In contrast qualitative methods use purposeful sampling to select information-rich cases that provide great detail about issues central to the research problem (Patton 1990). Thus in qualitative research, random sampling is not necessary or even desirable (Perry 1998; Patton and Appelbaum 2003).

The purposeful sampling strategy employed in this research involved selecting research participants based on geography. That is, the selection of research participants was purposeful in that geographic location of pastoral properties determined who would be interviewed. In this way, three case study regions were selected comprising of contiguous pastoral properties ranging in size, terrain, vegetation, proximity to a major regional centre and proximity to a national park. The landholders on each of these properties were asked to participate in the research, along with the kangaroo harvesters that harvest on those properties and the meat processors who buy kangaroo carcasses from these harvesters. A map of the case

study regions is provided in Articles 2, 3 and 4. A brief description of each case study area is provided in Table 6, below.

Table 6: Description of case study regions

Attribute	Port Augusta region	Northern Flinders Ranges region	Marla / Oodnadatta region
Number of properties in case study region	11	12	9
Major land use	Sheep grazing	Sheep grazing	Cattle grazing
Average property size	770 km^2	1091 km^2	4112 km^2
Proximity to major regional centre	100 to 200 km	200 to 400 km	700 and 800 km
Proximity to national park	No national park within close proximity	Some properties adjoin Flinders Ranges National Park	No national park within close proximity
Terrain and vegetation	Undulating landscape with some with hilly, rocky terrain; variable vegetation including tussock grasslands, melaleuca and chenopod shrublands	Mountain ranges and wide flat plains; diverse vegetation from tussock grasslands to native forest	Much of the region is lowland sand and stony plains; vegetation dominated by tussock grasslands, acacia and chenopod shrublands

Source: National Land and Water Resources Audit website <http://www.audit.deh.gov.au> and data provided by the South Australian Department of Water, Land and Biodiversity Conservation.

The advantage of selecting case study regions based on geographic attributes was that the case study design incorporates multiple dimensions which has implications for the transferability of research findings (as discussed later, see page 58). However, selecting another sampling strategy would have delivered different benefits. For example, a snowball sampling strategy starts by asking 'who should I talk to about this topic?' to locate research participants that hold valuable information (Patton 1990). Such a sampling strategy would have ensured that each person asked to participate in the research held significant knowledge about kangaroo management, as identified by other people involved, and this could have added to the depth of the study. Also, a sampling strategy that traced individual kangaroo harvesters (rather than landholders) could have produced greater detail about the relationship networks that exist between different industry actors.

Engagement and saturation

Engagement is the researcher's investment of time in the field and must be of a duration that allows communication and understanding to develop (Baxter and Eyles 1997; Johnston et al. 2000). Just how much time is the correct amount of time in the field is discussed by Patton (1990) who suggests that field work is coming to an end when the researcher is no longer uncovering new information but is becoming increasingly occupied with analysis and verification processes. This point is referred to as 'saturation' (Patton 1990). This occurred for me after approximately 70 days in the field. The total amount of time spent in the field during this research was 111 days. Table 7 shows how much time (in days) was spent with both indigenous and non-indigenous research participants and in the phases of data collection and verification (or member checking). Appendix 1 (page 188) shows all field work including destinations and dates.

Table 7: Research days spent in the field

	Scoping study (providing information)	Time spent in the field collecting data	Time spent in the field verifying results
Indigenous research component	22 days	23 days	11 days
Non-indigenous research component	14 days	28 days	8 days

While on the topic of engagement, Patton and Appelbaum (2003:68) point out the importance of "the ability to get close to the object of study in order to find out what is happening". Trust between researcher and research participants is critical in this respect (Hall and Callery 2001). In this research, mutual trust was established in a number of ways. As a first step the research was introduced to people in face to face meetings without asking for anything in return. At this time an offer to answer questions was extended and some people raised issues pertinent to them. Some questions could be answered immediately, others were followed up at a later date by telephone. On the second visit to the research participants the interview was conducted. A number of research participants also received a third visit for the purpose of testing the research findings (discussed in more detail in the section on member checking, below). Trust was developed by having repeated contact with research participants, by being open and honest in answering all of their questions and

also by bush camping on properties rather than staying in hotels or similar accommodation. Bush camping proved not only to be more cost effective and practical in terms of conducting the research, but also gave me more 'credibility' or 'rapport' with research participants. Thus, I was warmly welcomed by research participants and felt mutual trust and respect.

Member checking

Baxter and Eyles (1997:515) advocate member checking as "one of the most important strategies" for enhancing credibility in qualitative research (see also Miles and Huberman 1984). Member checking involves revisits to some members of research group for the purpose of discussing research findings and is a process best approached as a reciprocal exercise or an 'exchange of ideas' (Baxter and Eyles 1997:515). As Patton (1990:267) states, when providing feedback to research participants "it is not possible to report everything one has observed". However, it is possible to report the main products of data collection and analysis. In this research, the main findings were presented to a subset of research participants who were selected on the basis of interest in the research and accessibility, that is, people who live on or near the Stuart Highway were easier to access than those who live on properties only accessible by dirt tracks. The research findings were discussed in an open exchange of ideas. This process not only facilitated verification of the findings but also added further depth to the study.

In a separate but related process to member checking, the main findings were also presented to a group of people identified by research participants as 'industry experts'. Telephone conversations were also held with State government kangaroo management staff from South Australia, Queensland, New South Wales and Western Australia. Similarly to the member checking process, the reactions of these people to the findings were valuable for verification, depth, and in some cases provided alternate views or explanations for particular observations.

Peer debriefing

Peer debriefing is yet another technique useful for enhancing the credibility of qualitative research (Lincoln and Guba 1985; Lietz et al. 2006). Baxter and Eyles (1997:514) describe peer debriefing as the process of "exposing data and

interpretations to a respected colleague in order to point up possible sources of misinterpretation". In this research, peer debriefing occurred during field work and data analysis. It was very useful to talk candidly with field assistant, Luke Diddams, within a few hours of interviews. We would share our thoughts on the interview content and how issues were similar or different to those raised by other research participants. We explored some of the big issues emerging from the work in detail and how we could see these issues impacting on kangaroo management. Themes that emerged during data analysis were also discussed with Luke and with research supervisors. Dr Jocelyn Davies was particularly helpful during this stage by asking probing questions that facilitated deeper analysis and by asking the 'difficult' questions that caused me to reflect on the research and my position in the process.

Interview transcription and the use of quotations

Hall and Callery (2001) cite verbatim interview transcription as a strategy for demonstrating credibility in qualitative research. The transcription process in this research was thorough and lengthy. Each interview was transcribed verbatim and most of this transcription was conducted personally which facilitated the depth of understanding that emerged during data analysis. Verbatim transcripts were valuable for the extraction of quotes for use in written reports and peer-reviewed papers. Throughout the written documents produced from this research, quotes from research participants illustrate the findings and facilitate the reader's understanding of the ideas presented (see also Russell and Gregory 2003). The use of quotes also adds to the credibility of the research (Baxter and Eyles 1997; Sandelowski and Barroso 2002). According to Smith (1987:177) quotations from research participants provide 'vivid' evidence that the observations recorded have actually taken place.

Triangulation

Triangulation is the process of combining three or more social research methods. The advantage of triangulation is that different methods have different strengths, weaknesses and biases. The assumption is that by combining three or more methods, bias is reduced and validity enhanced (Blaikie 1991). Triangulation has been suggested as "one of the most powerful techniques for strengthening credibility" (Baxter and Eyles 1997:514; see also Bryman 1984; Lincoln and Guba 1985; Patton 1990). Some triangulation of research methods was employed in this research through

the use of interview data, official documents concerning kangaroo management and quantitative data provided by industry regulators about the number of kangaroos harvested in particular regions over time.

Transferability

External validity, or generalisability, in quantitative research describes "the approximate validity with which we infer that the presumed causal relationship can be generalised to and across alternate measures of the cause and effect" (Cook and Campbell 1979:37). Qualitative researchers rarely claim that generalisations can be made from the results of their study (Baxter and Eyles 1997). This is largely due to the traditional, positivist view that generalisations are possible only from broad, quantitative studies and cannot possibly be drawn from in-depth, qualitative studies (Flyvbjerg 2006). Lincoln and Guba (1985) argue that qualitative research is not suited to generalisation but that findings can be transferable. These authors explain that in quantitative inquiry it is expected that findings can be generalised to all contexts within a population. However qualitative inquiry aims for transferability based on the "degree of similarity between sending and receiving contexts" (Lincoln and Guba 1985:297). That is, transferability is the degree to which the findings of qualitative research can be transferred to similar situations.

In this research, findings are transferable within South Australia where commercial kangaroo harvest occurs. Two attributes of the case study design specifically enhanced the transferability of findings within the South Australian context. Firstly, the case study consists of multiple sites. A multiple-unit study increases the likelihood that findings will transfer (Baxter and Eyles 1997) and the researcher's confidence in the transferability (Gerring 2004). Secondly, the case study is multi-dimensional. Perry (1998) discusses the main advantage of multi-dimensional case studies in terms of replication which in turn enhances transferability. The multi-dimensional design of this case-study research is illustrated in Table 6 (page 54) which shows the dimensions of proximity to a major regional centre, property size, pastoral enterprise type, proximity to a major regional national park, terrain and vegetation.

The context specificity of this study could be considered a limitation of the research design. A quantitative study that gathered data from other Australian States could

have generated findings transferable to other States where kangaroo harvest occurs. However the depth of understanding developed in this study would have been compromised. As discussed earlier, research design involves a trade-off between knowing more about less or less about more. Nonetheless there are a number of broad findings from this research that can be applied outside South Australia to kangaroo management in other States such as the need for flexibility to manage a mobile resource (see Article 3, Chapter 6). The transferability of the research findings was tested using a comparative study of kangaroos, moose and some other mobile and overabundant wildlife species. In Chapter 9, the 'big picture' findings of kangaroo management are applied outside of kangaroo management and across international borders.

Dependability

Reliability in the quantitative research tradition has been defined by Kerlinger 1973:422) using the terms "dependability, stability, consistency, predictability and accuracy" and is usually tested through replication (Lincoln and Guba 1985). The qualitative synonym is dependability which is the ability of the research to demonstrate stability and consistency (Riege 2003). In this research, dependability was achieved in data collection through the use of interview question guides (Appendix 2) that were consistent and structurally the same for all three groups of non-indigenous research participants. The interview question guide used for indigenous research participants differed from the guide for non-indigenous participants because the research objectives for indigenous and non-indigenous participants were different. The research objectives (see page 3) relating to non-indigenous research participants focus on developing an understanding of the harvest rates, institutional settings and social dimensions of kangaroo harvest. The research objective for the indigenous component is to develop an understanding of Aboriginal people's interests in, and perspectives on, kangaroo management and harvest. The interview question guides are reproduced at Appendix 2 (page 189).

Consistency in data analysis was enhanced in two ways: through the use of the qualitative data analysis software package, NVivo, and by the use of grounded theory methods which build 'systematic checks' into data analysis (Charmanz 2006:23). NVivo software is a useful tool for managing complex and rich qualitative data.

Importantly, the software package promotes consistency by assisting data management and retrieval. It does not analyse the data – that is the researcher's task. Consistency and dependability in data analysis were achieved by employing grounded theory methods that allowed themes to emerge independently of preconceptions held by the researcher (Strauss and Corbin 1990). Next, by moving back and forth between the data and the analytical process systematically, patterns in the data became clear. On analysing patterns and grouping data accordingly, one is then able to say: "under these conditions this happens; whereas under these conditions, this is what occurs" (Strauss and Corbin 1990:130). Thus, using grounded theory methods enhanced, not only the dependability of the research by ensuring consistency in data analysis, but also credibility by increasing the likelihood that the findings would make sense to the people involved.

Lincoln and Guba (1985) suggest that strategies that increase credibility will usually also increase dependability. Furthermore, they assert that demonstrating credibility is sufficient to establish dependability. These authors and others (see Baxter and Eyles 1997) also argue that these two criterion should not be collapsed into one. Lincoln and Guba (1985) explain that while credibility measures establish dependability in practice, it is important to also establish dependability in principle. Baxter and Eyles (1997) elaborate by suggesting that credibility refers directly to issues of appropriate representation of the research participant's experiences, whereas dependability is more a matter of consistency in the research approach. As such, the task of the above discussion relating to dependability in this research process has focussed on consistency in data collection and analysis.

Confirmability

Baxter and Eyles (1997:517) describe "conventional objectivity" in terms of the following assumptions: "there is a single, largely unchanging reality; good data may reflect only that reality; and, when the researcher disturbs the data or the reality, objectivity is compromised". In a similar fashion the qualitative criteria of confirmability directs attention to the data and the interpretations drawn (Lincoln and Guba 1985). Essentially confirmability seeks to establish that the findings are confirmable and determined by data rather than motivations or interests of the researcher (Baxter and Eyles 1997).

Confirmability, analogous to the conventional principle of objectivity, requires that interpretations derived from the data are a result of the research process and not the bias or motivation of the researcher (Lincoln and Guba 1985). An audit trail is the most important strategy for demonstrating confirmability in qualitative inquiry (Lincoln and Guba 1985; Morse et al. 2002; Baxter and Eyles 1997). The audit trail for this research has three main components:

- a database containing all coded interview transcripts
- the products of data collection and analysis including notes regarding the big concepts that emerged, quantitative summaries and field notes
- the formal products of the research including findings and conclusions as presented to research participants (see Appendix 3), the final reports (as listed on page xi) and peer-reviewed papers (as they appear in this thesis).

Confirmability of this research has further been enhanced through researcher 'responsiveness' and openness. Morse et al. (2002) note that it is "essential that the investigator remain open, use sensitivity, creativity and insight and be willing to relinquish any ideas that are poorly supported regardless of the excitement and the potential that they first appear to provide". As Baxter and Eyles (1997) have noted a relationship exists between credibility, transferability dependability and confirmability. Therefore, some of the strategies already discussed, such as peer debriefing and the use of grounded theory methods for data analysis, have also contributed to the confirmability of this research.

Limitations

Some limitations of the research method have been discussed throughout this chapter in an implicit manner, but the explicit statement of limitations is important. The limitations of this research are related to the selection of the case study as a research approach over other methods. The major limitations of sampling strategy and generalisability are briefly described in dot points below with reference to the pages where these are discussed in text for easy reference.

- The choice of sampling strategy affected the selection of research participants. This is turn has the potential affect the research findings. See page 54 for a

discussion of the sampling strategy employed and other options that may have been utilised.

- The findings of qualitative research are usually considered to be unsuitable to generalise to other contexts. This issue is covered in the section on transferability on page 58.

Conclusion

The purpose of this chapter was to explain the overall research approach from the selection of realism as the research paradigm, to the selection of case study research as appropriate methodology and to list the specific methods or activities that were employed. The research methods and activities have been presented here in order to highlight how each contributed to the validity of this research. Each article in the following chapters contains a description of methods. The criteria of credibility, transferability, dependability and confirmability for establishing validity in qualitative inquiry were applied to this research as useful general principles for guiding evaluation. Measuring this research against these criteria suggests that the research process has produced a valid account of kangaroo management in South Australia.

Chapter 4

Social and cultural dimensions of commercial kangaroo harvest in South Australia

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This chapter contains Article 1, an introduction to the research and presentation of preliminary findings. It appeared in the *Australian Journal of Experimental Agriculture* in 2005, volume 45, pages 1239-1243. This paper was presented by Dana Thomsen at the Australian Farming Systems Association Conference in Toowoomba, September 2003. It won Best Paper Theme 5 – Uncommon Processes and Partnerships for Farming Systems Change.

Mt. Serle Station, Flinders Ranges, South Australia, January 2004.

Thomsen, D. and Davies, J. (2005) Social and cultural dimensions of commercial kangaroo harvest in South Australia.
Australian Journal of Experimental Agriculture, v.45 (10) pp. 1239-1243, 2005

Chapter 5

Improving the capacity for the kangaroo industry to benefit South Australian regional communities and rangeland environments

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Article 2 is presented in this chapter. It explores the problem of South Australia's low kangaroo harvest rate and presents recommendations for improving the capacity for commercial kangaroo harvest to benefit rural communities. This article was published in the *Australasian Journal of Regional Studies* in 2007, volume 13, issue 1, pages 83-100.

Kangaroos being 'field dressed' on the side of a kangaroo harvester's vehicle, Flinders Ranges South Australia, July 2003.

Thomsen, D. and Davies, J. (2007) Improving the capacity for the kangaroo industry to benefit South Australian regional communities and rangeland environments. *Australasian Journal of Regional Studies, v.13 (1) pp. 83-100, 2007*

Chapter 6

Managing the commercial harvest of a common pool resource: rules norms, and shared strategies in the kangaroo industry

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In this chapter Article 3 is presented which examines the management regime for kangaroos in South Australia with a focus on the formal and informal rules, norms and shared strategies. This article was published in the *Australian Journal of Environmental Management* in 2007, volume 14, issue 2, pages 123-133.

Kangaroo harvester's vehicle awaiting unloading after a night's work, western Queensland, April 2003.

Thomsen, D. and Davies, J. (2007) Managing the commercial harvest of a common pool resource: rules norms, and shared strategies in the kangaroo industry. *Australian Journal of Environmental Management, v.14 (2) pp. 123-133, June 2007*

Published as: Rules, norms and strategies of kangaroo harvest

Chapter 7

From pest to resource: The prospects for financial return to landholders from commercial kangaroo harvest

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Article 4 is presented in this chapter. It examines the place of landholders in the kangaroo industry and the potential for kangaroos to contribute to on-farm income. This article was published in the *Australian Farm Business Management Journal* in 2006, volume 3, number 2, pages 92-102. This article was presented by Dana Thomsen at the Australasian Farm Business Management Network Conference in Geelong, September 2006, and was named runner up in the award of best paper.

Research assistant, Luke Diddams, at Leigh Creek Station Shearer's quarters, Flinders Ranges South Australia, July 2003.

Thomsen, D. and Davies, J. (2006) From pest to resource: the prospects for financial return to landholders from commercial kangaroo harvest.
Australian Farm Business Management Journal, v.13 (2) pp. 92-102

Chapter 8

Aboriginal perspectives on kangaroo management in South Australia

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The final article in this series of five is presented in this chapter. This article presents the views of Aboriginal research participants regarding kangaroo management and the commercial harvest of kangaroos in South Australia. It appeared in *The Rangeland Journal* in 2006, volume 28, pages 127-137. This article was presented by Dana Thomsen at the Australian Rangeland Society Conference held in Alice Springs, July 2004 and won the Young Researcher Prize in the category of Rangeland Biological Sciences, Best Paper.

NOTE: This image is included on page 119 of the print copy of the thesis held in the University of Adelaide Library.

Research assistants and good friends, from left: Joseph Lennon, Yami Lester and Kado Muir, at Wallatinna Station, far north South Australia, March 2003.

Thomsen, D., Muir, K. and Davies, J. (2006) Aboriginal perspectives on kangaroo management in South Australia.
The Rangeland Journal, v.28 (2) pp. 127-137, 2006

Chapter 9

Transferability to other overabundant and mobile wildlife resources: comparing management of kangaroos and moose

A red kangaroo at rest, Central Australia, August 2005.

Introduction

As discussed in Article 2, the future viability of commercial kangaroo harvest in South Australia is important for a range of reasons. The harvest has direct and indirect production outcomes for the kangaroo industry, regional communities and the environment. Direct outcomes include revenue generation for harvesters and meat processors and the contribution to management of total grazing pressure on pastoral leases. Indirect production outcomes include increase in social and human capital in regional areas and economic contributions to regional communities.

The contributions that the commercial kangaroo harvest makes to rural communities and to South Australia, in terms of environmental and economic benefit, are described in some detail in Article 2. This article also establishes that the South Australian kangaroo industry is in decline. The major issues are:

- low harvest rate (Articles 1 and 2)
- landholders receive little or no economic return from kangaroos (Article 4)
- lack of flexibility in the management system (Articles 1 and 3)
- lack of involvement of industry stakeholders, especially landholders, harvesters and Aboriginal people (Articles 2, 3, 4 and 5).

This research has highlighted the need for reform of the kangaroo management system in South Australia. Article 2 outlines the key problems facing South Australia's kangaroo industry and makes recommendations for the future. These recommendations include:

- introduce flexibility to the management system
- address the lack of competition
- increase input from stakeholders
- boost harvester numbers and introduce incentives.

Thus, this research addresses the aim and the objectives. However, an outstanding question is whether the research findings are transferable to similar situations? In the Methodology chapter (Chapter 3), transferability - that is, the degree to which the findings of qualitative research can be applied to similar situations - was discussed as

a criterion for measuring the validity of the research. In order to test the transferability of the findings of this research it is necessary to identify wildlife resources that hold similar characteristics to kangaroos and then examine the findings against management approaches to those species.

The key characteristics of kangaroos that need to also be present in other species in order to establish similarity are:

- mobility across administrative boundaries
- overabundance caused by human induced environmental change
- overabundance leads to ecological and/or economic impacts
- population managed through consumptive use.

A literature search revealed other wild animal species that hold similar characteristics. It can be expected that the findings of this research may be transferable to the management of these species. Examples of comparable species are:

Snow goose: At Hudson Bay in Canada the snow goose (*Anser caerulescens caerulescens*), a migratory species, has increased in population and expanded its range as a result of the availability of feed from agricultural crops. The overabundant snow goose population is moving into habitat previously occupied by other species, such as Canada geese, sandpipers and phalaropes, and is causing adverse impacts to vegetation. The snow goose population is managed through harvest by licensed hunters. In recent years the snow goose harvest has doubled coinciding with increased bag limits but the population is continuing to increase (Ben-Ari 1998).

White-tailed deer: The white-tailed deer (*Odocoileus virginianus*) population in the USA has increased in response to human-induced landscape change. Although deer are harvested by recreational hunters, the problems of deer overabundance are increasing in many parts of the USA (Stromayer and Warren 1997; Brown et al. 2004).

Other species that exhibit these characteristics of mobility, overabundance and consumptive use include the sooty shearwater (*Puffinus griseus*) in New Zealand (Lyver 2000) and moose (*Alces alces*) in Finland, Sweden and Norway (Lavsund et al. 2003).

In this chapter, the research findings presented in the five preceding articles are highlighted and extended using a comparative study. The focus of this comparative study is the comparison of management regimes and social impacts on the harvest of kangaroos in South Australia and moose in Finland. Examples from some of the other wildlife management issues mentioned above will also be drawn upon to illustrate the applicability of the findings to resources that are overabundant, mobile and exposed to consumptive use.

Comparable resources: kangaroos and moose

Kangaroos and moose are physically very different wildlife resources. The kangaroo is a marsupial that "sits on its tail, hops on its hind legs, fights with its forepaws, and carries its young in a pocket" (McCollough and McCollough 2000:1). It is an animal that the early European settlers in Australia looked upon with amazement, having never seen a creature quite like it before (Hornadge 1972). In contrast, the moose is a European animal with which early settlers would have been more familiar. Moose can be described as a very large deer with adults standing over 2 m tall and weighing 500 kg or more. They generally inhabit the taiga zone surrounding the North Pole that encompasses Denmark, Norway, Sweden, Iceland, Finland, northern Russia, Siberia and parts of North America (Leikola 2002).

Despite the obvious physical differences, these two animals have key features that make a comparative study of their management interesting and useful. Kangaroos and moose are common pool resources managed by the State and harvested by licensed harvesters under a quota system. Management goals for kangaroos and moose generally involve both protection of the species and minimisation of the detrimental impacts of overabundance (Pople and Grigg 1999; Horne and Petajisto 2003Both species are important as game, are highly mobile, have a propensity to overabundance, and their management is through consumptive use.

Just as kangaroos have been an important animal from pre-European history to the present, moose have long been an important game animal in Finland (Luoma 2003). Historically, the indigenous Sami people valued moose as a source of food while the skins were used to produce clothing, footwear and tents (Ashihmina 2002). Today moose are harvested by Sami and others across Finland, just as in South Australia, kangaroos are harvested by both Aboriginal people and commercial harvesters (Article 5).

Mobility is a key feature of both kangaroos and moose. Kangaroos generally have a relatively stable home range of around 20km^2, but they have been found to travel large distances (up to 300 km) during drought (McCollough and McCollough 2000). Moose move across the landscape between summer and winter habitats and during the mating season (Game and Fisheries Research 2005; Lehtonen 1998). Both resources move across private properties, public lands and different administrative boundaries.

Kangaroos and moose hold strikingly similar characteristics in terms of overabundance problems. Both species occurred in low numbers in the past and are now overabundant and increasing in population in many areas. Human activity in the environments of both species has altered plant and animal communities in their favour. In Australia the landscape has been extensively modified to facilitate livestock production. As explained in Articles 2 and 3, kangaroo populations have increased to levels of overabundance due to land clearing which promoted the expansion of grasslands, the introduction of water points and control of the only native predator of kangaroos, the dingo (Calaby and Grigg 1989). In Finland intensive forest management has increased the distribution of young forests, creating improved browsing conditions for moose (Edenius et al. 2002). A lack of natural predation further promotes moose population growth. Widespread control of the wolf, a natural predator of moose, in the 19th Century and the first half of the 20th Century led to a significant reduction in the wolf population and an increase in moose numbers. Although the wolf population is slowly rebuilding, there are currently only about 200 wolves in Finland (Aspi et al. 2006).

Overabundant kangaroo and moose populations cause considerable economic losses and costs to society through ecological damage and damage to property. In Australia

landholders have claimed that overabundant kangaroos cause damage to crops and fences and in the pastoral rangelands overabundant kangaroos can impact on production values by increasing total grazing pressure. Another economic impact of overabundant kangaroos is vehicle collision that causes injury and damage to vehicles (Abu-Zidan et al. 2002). In some areas and at some times, the verges of outback highways are strewn with the carcasses of dead kangaroos.

Similarly, Finland experiences economic and ecological impacts of moose overabundance through traffic accidents and damage to forests and agricultural crops (Heikkila and Aarnio 2001). Moose related traffic accidents have been estimated to cost Finland €100m each year (Paajanen and Turtiainen 2005) and forest browsing by overabundant moose can suppress or redistribute forage species (Edenius et al. 2002). In Finland management policy for moose has "adopted a compensation policy to redistribute some of the benefits from moose to the group that suffers browsing damage in forests" (Horne and Petajisto 2003:473). An increasing moose population has caused the amount of compensation paid by the Finnish government to double since the 1990s (Paajanen and Turtiainen 2005).

The key management tool for both the kangaroo population in South Australia and the moose population in Finland is harvest by licensed hunting. The commercial kangaroo industry, and to a lesser extent culling by landholders, are the only methods employed to manage overabundant kangaroos in Australia's rangeland environments. Likewise in Finland hunting "plays a major role in moose population dynamics" (Luoma 2002:5) because the "only significant regulator of the moose population size is hunting" (Lehtonen 1998:174). Both kangaroo harvest and moose harvest contribute to the national economy of Australia and Finland respectively. The value of Australia's kangaroo harvest was estimated to exceed over A$200m in 2005 (Commonwealth of Australia 2005) and the value of meat harvested from Finnish moose contributed approximately €50m to the national economy in 2004 (Paajanen and Turtiainen 2005). This value equates to 0.9% of Australia's GDP and 0.3% of Finland's GDP. In both cases value is relatively low, but for rural communities the economic flow on effects of harvest activities can be important.

The management of these overabundant species through harvest is important to landholders in South Australia's grazing lands and to landowners in Finnish forests. Article 4 describes how the South Australian kangaroo harvest brings ecological, economic and social benefits to rural and regional areas. Kangaroo harvest helps landholders to manage total grazing pressure which promotes agricultural production and reduces the adverse ecological impacts of overgrazing. Finnish farmers derive similar advantages from the harvest of moose as a reduction in forest browsing brings ecological and production advantages. However, the value of harvest to rural communities accounts for more than the improved economic viability of farms and contribution to ecological sustainability. Harvest activities also often have social functions. Kangaroo harvest brings people and skills to rural and regional areas in South Australia, while Finnish hunting clubs bring social benefits to rural areas by organising end-of-season festivities for local people (Selby 2007, Pellikka et al. 2005). Deer hunting in the USA has also been accredited with providing similar ecological (Stromayer and Warren 1997), economic (Peyton 2000) and social (Williams 2002) benefits. Thus, the finding of this research regarding the ecological, social and economic benefits that kangaroo harvest brings to rural and regional communities also appears to apply to the harvest of overabundant and mobile wildlife species in other countries.

Another trait of kangaroo harvest that is also found in moose harvest, is the voluntary constraints that harvesters apply in order to conserve the resource base. In Finland hunting clubs may voluntarily impose restrictions on their members in addition to restrictions set by regulatory authorities (Pellikka 2005). The harvest trend for moose in Finland places greater harvest effort on individuals with lower reproductive value, such as males and young animals, and less on female animals in their prime reproductive years (Luoma 2002). Similarly, South Australian kangaroo harvesters follow voluntary harvest restrictions by not harvesting females with young in the pouch or at foot, as outlined in Article 3. Pellikka (2005:22) recognised that Finnish moose hunters are 'prudent predators', a term that also applies to kangaroo harvesters (demonstrated by their conservative harvest practices as discussed in Article 3) and to deer hunters in the USA (Holsman 2000). Arguably, this would often be the case for people harvesting other wildlife resources because harvesters have a stake in ensuring sustainable harvest and reproductive fitness of the species.

Do the management issues relevant to kangaroo also apply to moose?

Here the main issues for kangaroo management (as outlined on page 134) are examined in relation to the Finnish moose management system.

Low harvest rate

The kangaroo harvest rate in South Australia over the past ten years has averaged less than half the quota made available by government authorities. Potential drivers of low harvest rate are suggested in Chapter 5 (Article 2) to be:

- institutional - few harvesters hold exclusive harvest rights to too many properties
- geographic - isolation and lack of infrastructure
- economic - low prices paid to harvesters and high costs incurred to access kangaroos in rough terrain, meat processor preference not to process smaller kangaroos
- social - low number of harvesters in South Australia and low recruitment rate.

Unfortunately Finnish data on moose harvest rate, as a percentage of quota, were not accessible using electronic sources during this desk top study. However, a literature search revealed that Finland's moose population has steadily increased since the 1960s (Lehtonen 1998) and is increasingly causing damage to crops, forests and property (Heikkila and Aarnio 2001). The recommended moose density in Finland is 3 to 4 animals per 1,000 ha. However, moose density in winter habitats can reach levels of over 10 animals per 1,000 ha (Jalkanen 2001). This suggests that the moose harvest is not always effective at keeping the population at an optimal level - that is, a viable but not overabundant population.

Evidence from Finnish sources shows that institutional, social and geographic influences impact on moose harvest rate (Jaren et al. 2003; Paajanen and Turtiainen 2005; Pellikka et al. 2005; Selby et al. 2005). Little information was available regarding economic impacts, but the potential for such impacts seems high. The

institutional impacts on harvest rates are discussed later; in this section the focus is on social and geographic factors that influence harvest.

Selby et al. (2005) discuss some of the challenges to moose harvest as a management tool. They identify both social and physical or geographic factors that can impact on moose harvest. The moose hunt requires a land area of over 1,000 ha and hunters generally travel long distances on foot. An average of 16.5 person-days per moose is spent for the hunt that occurs from October to December. At this time in Finland the temperature is often extremely low, the snow can be thick and the days are short. Thus the moose hunt is carried out under difficult conditions. Selby et al. (2005:72) state that participating in the moose hunt "is arduous and requires good physical fitness". Similarly kangaroo harvesters work under difficult conditions because they conduct harvest at night and often travel long distances to the place of harvest. Although the harvest effort per kangaroo is much less, with between 20 and 50 kangaroos being harvested per night by each harvester, the distances travelled mean that many kangaroo harvesters live in bush camps for a number of weeks at a time which can place strain on family relationships (see Article 2). In this way, geographic and physical factors influence social dimensions of harvest.

The social issues for moose harvest have been described by Selby et al. (2005) who suggest that a potential decline in harvester numbers may be a problem for moose management in the future. Although "until now there has been a strong correlation between the number of moose to be harvested and the number of hunters willing to hunt moose", Selby et al. (2005:64) state that declining farm numbers and the exodus of people from rural to urban areas may have an adverse impact on the retention and recruitment of moose harvesters. In the future, fewer harvesters will lead to fewer moose harvested and a reduction in the ability of moose harvest to regulate the population. This situation has already been realised in South Australia where kangaroo harvester numbers are lower than any other State and so is the percentage of the quota harvested (see Article 2).

South Australia and Finland are both experiencing effects of rural economic decline. Retention of people in rural areas is proving challenging to rural communities in these countries (Alston 2002; Selby et al. 2005). Furthermore, many rural communities are

facing an age crisis, as young people are most likely to seek opportunities offered in urban areas. Alston (2004:300) states that "while the loss of young people, and the greater loss of young women, is driven by a lack of employment options, [and] the need to access tertiary education, it is also driven by a need to escape the small town milieu". The decline in harvester numbers in the South Australian kangaroo industry is predicted to escalate, because harvesters are an aging population (Thomsen and Davies 2007). Similarly, Selby et al. (2005) note that the aging rural population in Finland corresponds with an increase in the average age of people participating in moose harvest. These authors have observed that there are few young people taking an interest in moose harvest or other hunting activities. A declining interest in hunting as a recreational pursuit is a trend that is also apparent in other countries, including the USA where hunter recruitment has declined since the 1970s (Enck et al. 2000).

For both kangaroo harvest in South Australia and moose harvest in Finland, low harvester recruitment rate is a serious problem. Harvest can only be a useful tool for population regulation when there are sufficient harvesters to carry out the task. Generally, for new harvesters to be recruited they need to have had some exposure to hunting (Organ and Fritzell 2000). Kangaroo harvesters most often enter the profession through a family history of involvement in the industry. Others become kangaroo harvesters because they have friends involved in the industry (Thomsen and Davies 2007). The decline in harvester numbers means fewer opportunities for exposure to harvest activities and reduced potential to recruit new harvesters.

In a survey of Finnish hunting clubs, Selby et al. (2005:68) found that 60% of hunting clubs "reported that applications for membership had not exceeded membership openings". Therefore membership supply is actually greater than demand and more new members could have entered these clubs. Selby et al. (2005:70) also report that moose hunting clubs have a 'closed nature' in that new members may be restricted from entering, based on applicants not meeting entry pre-conditions, such as residence or land ownership in the hunting area, or a family relationship to an existing member. As Heikkila and Aarnio (2001:90) observed, "close connections" are required for hunters to become part of a hunting group.

People wanting to enter the South Australian kangaroo harvest face a similar problem. Article 2 describes the 'closed nature' of the South Australian kangaroo industry where one kangaroo harvester generally holds exclusive harvest rights to a number of properties. Thus, each harvester protectively holds the properties to which they have secured harvest rights and new entrants to the industry may find it difficult to source properties on which to conduct harvest. Article 2 recommends institutional reform of kangaroo management including removal of property level quota allocations that produced the 'one harvester per property' problem. In relation to the problems faced in Finland, Selby et al. (2005:73) recommend that the preconditions for hunting club membership be modified to facilitate increased membership and state that "new rural land leasing arrangements may be required to enable new urban-based moose hunting clubs to operate".

In both South Australia and Finland, there is a need to boost harvester numbers. However, the cultural trend away from hunting activities in western countries is a factor that will continue to influence harvester recruitment for kangaroos, moose and other species where management relies on population control through harvest activities. Article 2 recommends the introduction of mechanisms designed to boost harvester numbers and harvest rate, including training and incentive programs.

Harvester recruitment problems are influencing the effectiveness of harvest as a population management tool for kangaroo management. With the costly and ineffective nature of non-lethal management options such as sterilisation or relocation (Ness 2003), the recruitment problems facing harvesting as a management tool require urgent attention. In South Australia, and in other regions where harvest is conducted, the continuation of these activities is important to local communities, increasing the impetus to ensure harvest of overabundant kangaroos remains a viable and attractive activity (see Article 2).

Landholders receive little or no economic return

This research examined the role of South Australian landholders in commercial kangaroo harvest. As outlined in Article 4, the commercial harvest of kangaroos has been proposed as an alternative to livestock grazing in the rangelands that could bring significant environmental benefits to degraded rangeland habitats. However, kangaroo

harvest as a replacement for livestock grazing systems is yet to be embraced by landholders due to lack of secure property rights in kangaroos and the relatively low financial returns possible. Article 4 outlines the ways that landholders may choose to be involved in the kangaroo industry and suggests that before kangaroo harvest will contribute to the economic viability of South Australian pastoral enterprises, the property rights issue must be addressed and landholders need to be accepted as a valuable industry stakeholder.

The situation is quite different in Finland where a majority of moose hunters are also landowners (Heikkila and Aarnio 2001). In Finland, landowners were granted hunting rights to wildlife at the end of the 18th Century in order to address resource depletion problems caused by an open access regime. As a result, modern day Finnish landowners can exercise the right to hunt personally or they can sell this right to a hunting club (Horne and Petajisto 2003). Most landowners do not request a monetary return but may negotiate an in-kind 'rent' such as a share of the meat. As described earlier, a large area of land is required for hunting moose, but property size in Finland is generally small. Therefore, hunting groups usually develop agreements with a number of landowners (Heikkila and Aarnio 2001). In this way, hunting rights conferred to Finnish landowners have limited commercial value.

Finnish landowners may receive compensation for moose damage derived from hunting licence fees. However, Jalkanen (2001:159) states that the monetary compensation landowners receive as a result of moose forest damage is "considered inadequate". Thus, the Finnish situation is similar to South Australia where landholders/landowners derive little or no direct financial benefit from the harvest of overabundant wild animals.

Lack of flexibility in the management system

A major problem for kangaroo management in South Australia identified in this research is the lack of flexibility within the management system. Article 3 describes the structure of the system that specifies the allocation of one tag to one property and one harvester, and discusses how kangaroo harvesters manipulate the formal rules to overcome the inflexibility of the South Australian management system.

Paajanen and Turtiainen (2005) acknowledge that flexibility is also a problem in the management system for moose in Finland. Granting of hunting licences lacks flexibility, and in practice this weakness has been overcome at the local level by manipulation of the formal rules. For example, hunting licences cannot be granted outside the dates specified by the regulatory authority. But some local game management authorities have circumvented this requirement by introducing 'bank' or 'shelf' licences that effectively extend the hunting season beyond the specified hunting dates. This is an example of a locally devised strategy that introduces greater flexibility to moose management. Thus, just as a key feature of kangaroo management in South Australia is deviation from the formal rules set by the regulatory authority, Paajanen and Turtiainen (2005) state that the management system in some Finnish districts is actually quite different to what the government agency intended.

For a management system to be effective it needs to be responsive to the physical attributes of the resource being managed. A key physical attribute of kangaroos and moose is mobility, which in turn impacts directly on management. Despite the mobility of kangaroos and moose this comparative study has identified a lack of flexibility in both management systems. The recommendation in Article 2 and 3 regarding the need for the kangaroo management system to introduce flexibility in order to respond to the mobility of the kangaroo population also applies to moose management and possibly the management of other overabundant and mobile wildlife resources.

A further comparison can be made with management of the overabundant and mobile white-tailed deer in the USA. Because deer management varies across different States the amount of flexibility in the management system also varies between States. In a study of hunting management impacts on landowners across various States, Leal and Grewell (1999) found that in most States landowners seek more flexibility in management programs.

Another example of a lack of flexibility in the management of an overabundant and mobile wildlife population is the management of snow geese in Canada. Ankney (1996) asserts that "creative, new approaches must be made available to managers" to increase harvest rates and address the ecological and economic problems created by

snow goose overabundance. He calls for a relaxation of strict hunting season regulations, legalisation of the sale of harvested birds and a broadening of the allowable hunting techniques. In recent years the hunting season has been extended into spring. However, Bechet et al. (2003) found that this alteration is not sufficient to reduce the population or the damage being caused. They suggest that staggered hunting opening dates may be required. But considering the mobility of the snow goose and the seriousness of the overabundance problems, managers may need to consider introducing greater flexibility to address the management issues. The examples of kangaroo, moose, deer and snow goose management highlight the need for flexibility in the management of overabundant and mobile wildlife resources.

Lack of involvement of industry stakeholders

As previously noted, the management systems of kangaroos and moose both involve the national government overseeing the harvest. In Australia, the Federal Government regulates exports and approves harvest quotas recommended by the States, while in Finland the national government sets targets for population density by determining the length of the hunting season, providing recommendations for target moose density, collecting licence revenue and setting standards for the safety and efficiency of hunting equipment (Heikkila and Aarnio 2001; Horne and Petajisto 2003; Pellikka 2005). The difference between the two countries may be related to the different constitutional roles of the national governments. In Australia, the management of kangaroos is the responsibility of State governments, but in Finland most management activities occur at the district and local level (Heikkila and Aarnio 2001).

In Finland, although target densities are prescribed by the national government, the setting of harvest quotas occurs at the district level. There are fifteen game management districts in Finland and each sets quota according to estimates of district population density. At the local level hunting clubs participate in population monitoring and often regulate the activities of their members. Such regulation usually involves voluntary hunting restrictions that aim to ensure sustainable harvest over time (Pellikka 2005).

When people are involved in making management decisions they will be more likely to adhere to rules or restriction (Ostrom et al. 1999). This is evident in the voluntary

harvest restrictions of moose hunting clubs in Finland (Pellikka 2005). Unlike South Australian kangaroo management, where most people 'on the ground' have little or no opportunity to influence management, in Finland landowners and moose hunters are involved through local hunter organisations that have a role in decision-making regarding the size and specifics of the harvest, population monitoring and determining population estimates (Horne and Petajisto 2003). In relation to population monitoring Pellikka (2005) found that Finnish hunters are capable of providing reliable information. Article 3 discusses the local knowledge held by South Australian landholders and kangaroo harvesters and the contribution that they could make to kangaroo population monitoring. South Australia could learn from the Finnish experience and trust and value knowledge held by local people.

The kangaroo management system in South Australia generates a lot of data – on kangaroo populations, quotas, harvest rates, locations and movement of carcasses. Little of this information is fed back to people involved in the system in ways that might help them understand outcomes from their decisions and actions. We have found that there is a lot of data that is difficult to access without concerted effort. There are also uncertainties and errors in data where institutions are inappropriate and ineffective, for example tag swapping (see Article 3). The Finnish moose management system has also been criticised for "poor utilisation of available data" (Paajanen and Turtiainen 2005) suggesting that data management is also a problem for other mobile wildlife resources. However, good data management and feedback to local people is important. Pellikka (2005) affirms that feedback to participants ensures that people contributing to monitoring are receiving the full value of their participation.

Despite the involvement of local people in moose management through monitoring and other ways, Ericsson (2003:20) claims that:

> "Although humans play a significant role in moose management, the necessity of collecting and utilizing information about the human user has seldom been properly integrated into moose research. If we wish to manage moose optimally, we must better incorporate the human dimension".

This statement is equally applicable to kangaroo management.

Indigenous involvement in wildlife management

In Finland, as in Australia, indigenous people are largely overlooked in the management of wildlife resources. Article 5 describes the contribution that Aboriginal people could make to South Australian kangaroo management, and it is likely that the Sami have something to offer moose management in Finland. There are about 7,000 Sami in Finland (Ministry of Agriculture and Forestry 2000) and under the Finnish Constitution Sami are guaranteed "the right to maintain and develop their own language and culture, which also includes traditional natural resource industries (reindeer husbandry, fishing and hunting)" (Ministry of Agriculture and Forestry 2000:42).

Helander-Rendall (2005) suggests that colonial attitudes still prevail in Finland. She describes how the formalised rights of Sami people, enshrined in Finnish legislation, have not been translated into practice. Although Finnish legislation mandates negotiation with Sami regarding wide-ranging environmental and social issues, the Finnish government has failed to enter into such negotiations. Helander-Rendall (2005:21) asserts that the legislation is of little effect as "traditional Sami livelihoods regularly have to give way to competing interests" including, but not limited to, "economic development based on meat production".

The value of 'people on the ground'

There are advantages in involving people 'on the ground'. Scientific knowledge, local and indigenous knowledge can all contribute valid knowledge for wildlife management (Berkes et al. 1991). Science provides the knowledge base for biology and life histories of harvested species, large scale changes in populations and predictions of future population trends (Kessler et al. 1992). People who live and work in close proximity to the wildlife resource hold knowledge of density, movements and habits, particularly at local and regional scales. Experienced harvesters have a detailed understanding of aspects of animal behaviour and where density is likely to be greatest under particular weather or seasonal conditions. Observational data from harvesters about the size distribution of populations is utilised in moose management and could also be valuable to kangaroo management. Landholders have intimate knowledge of features of their property and may also hold

knowledge about animal density and movements. Indigenous knowledge is based on long-term cultural association with wildlife. For example, some Aboriginal people have detailed knowledge of aspects of kangaroo behaviour from observations during activities such as hunting. Each of these forms of knowledge is valid and can contribute to wildlife management. The challenge for wildlife managers is to incorporate this knowledge into management.

Lessons for managing overabundant and mobile wildlife

Comparison of the issues relevant to kangaroo management in South Australia with moose management in Finland has shown that the main issues are shared by these wildlife resources. Furthermore this discussion shows that there are other overabundant and mobile wildlife species that also share management issues. Chapters 4 and 5 (Articles 2 and 3) argue that mobile resources require management systems that have the flexibility to deal with mobility. This flexibility is critically important when mobile wildlife species are also overabundant because a lack of flexibility in management regimes may adversely impact on harvest rate and harvester retention and recruitment. While low harvest rates and harvester retention and recruitment are problems for the management of overabundant and mobile wildlife, overabundance problems can only escalate. Introducing the required flexibility to wildlife management may best be undertaken using an adaptive management approach.

Adaptive management

The term 'adaptive management' entered the natural resources literature in a paper by Walters and Hilborn (1976) that examined management of fisheries. These authors found that "management was not producing useful predictions for fisheries managers about the consequences of management initiatives" (Walters 1997:387). They promoted the idea that management decisions should be treated as "experimental treatments" to improve the quality of information available to managers and management capabilities (Walters 1997:387). Adaptive management, a term that is now used widely in the natural resources literature, is a flexible management approach where future actions are based on rigorous evaluation of past experience. As new information becomes available as a result of experience, monitoring or research, management strategies or techniques are modified as necessary (Parma and NCEAS

Working Group 1999). Adaptive management should not be confused with 'trial and error' or 'monitor and correct' management strategies which Walters (1997) asserts are a relabelling of traditional approaches and are not adaptive management (see also Parma and NCEAS Working Group 1999).

The fundamental principle of adaptive management is that management is a 'continual learning process' (Walters 1997). The approach draws heavily on adaptive control process theory which deals with the development of decision-making devices with a capacity to learn from previous experience. Just as adaptive control processes utilise feedback to modify action or behaviour, adaptive management incorporates feedback into decision-making for natural resource management to improve management outcomes. In both adaptive control processes and adaptive resource management, feedback improves capacity to deal with uncertainty and change (McLain and Lee 1996).

Applying adaptive management to overabundant and mobile wildlife

The management of overabundant and mobile wildlife is complicated by uncertainty and change. Decision makers responsible for kangaroo management set annual harvest quotas based on a single population monitoring event. This monitoring event itself contains uncertainty. For example - what is the optimal correction factor to use to extrapolate a population estimate from recorded observations? (see for example Caughley and Grigg 1981; Short and Bayliss 1985). After such decisions are made and the quota is set, the management system is not well equipped to deal with subsequent population fluctuations determined by rainfall or other environmental conditions. These localised and regional fluctuations are the main reason that South Australian kangaroo harvesters engage in the practice of tag swapping, as described in Article 3. As previously argued, a flexible management system is required to accommodate kangaroo mobility.

Deer management in the USA requires similar flexibility. Decker et al. (2002:7) advocate adaptive management for deer, stating that "a management program must be sufficiently flexible over time to adapt to what is learned as the program unfolds and managers gain experience". In some regions of the USA adaptive management has been successfully applied to the management of overabundant white-tailed deer. In

relation to snow goose management in Canada, Ben-Ari (1998) calls for adaptive management principles to be put into place, although this is yet to be applied. Arguably, the management of kangaroos and moose could also benefit from an adaptive approach. In particular, the flexible nature of adaptive management holds great value to the management of these mobile resources.

Adaptive management is important to the management of mobile resources and critical to the management of overabundant and mobile resources. However, adaptive management alone may not be sufficient. This research has shown that local people and their knowledge are important to wildlife management and that problems may arise when a central governing body is responsible for decision-making. Hybrid institutions that incorporate local and government institutions (see Chapter 2, page 19), often referred to as 'co-management', have the capacity to merge the knowledge and resources of local people and government authorities for improved natural resource management outcomes.

Adaptive co-management, a relatively new concept that has been applied to wildlife management, incorporates the "dynamic learning characteristic of adaptive management with the linkage characteristic of co-operative management" (Olsson et al. 2004:75). Fundamental to this approach is the involvement of diverse stakeholders and "social networks located at different levels of multiple centres or polycentric governance" (Olsson et al. 2004:87). This approach has great potential for the management of kangaroos and moose (and other overabundant and mobile wildlife) because it combines the flexibility of adaptive management with the input of local people that is the feature of co-management.

An adaptive co-management regime for kangaroo or moose should take the form of a collaborative management system between government administrators and the people who actively manage the resource. This would require structures for the involvement of people who harvest the resource and for landowners. Such structures are already in place in Finland where hunting clubs provide a mechanism for local involvement in management policy and decisions. However, kangaroo harvesters and landholders in South Australia do not have access to formal structures for participation in decision-making processes. Establishing a system to facilitate this participation seems critical

to harvester and landholder involvement and the involvement of Aboriginal people also requires similar targeted effort. Kangaroo management in South Australia is currently undergoing change. Recent efforts of South Australian government regulators to address the problems of kangaroo management identified in this research are discussed in the following chapter.

Conclusion

This comparative study of kangaroo management and moose management allowed some guided assessment of the transferability of the research findings. The issues and problems found in kangaroo management are also apparent in the management of moose. Of particular interest are the strikingly similar problems that result from inflexible management systems. The mobile nature of moose and kangaroos requires flexibility and adaptability in management to deal with overabundance issues. Furthermore, this research has found that harvesters are conservative of their resource base, which suggests that tight regulation is not always required in the management of overabundant and mobile wildlife resources.

Another factor relevant to both kangaroos and moose harvest management systems is the problem of rural decline and the decrease in interest of hunting as a sporting pastime. These factors have contributed to a decline in kangaroo harvester numbers in South Australia and are also expected to impact on the future of moose hunting in Finland. As both kangaroo and moose management rely on harvester activities to regulate the population, support for current harvesters to continue in their profession and incentives designed to boost harvest rate are important in the short term. Attracting new harvesters is also necessary and may be best achieved through training programs that introduce interested people to the harvest by making them familiar with gun handling and safety and the regulatory requirements for harvesters.

The very important role that harvesters play in the management of overabundant wildlife is an example of the importance of stakeholder involvement to effective management. Finland is more advanced than South Australia in terms of facilitating stakeholder involvement, as the South Australian kangaroo management program receives very little input from people considered to be 'on the ground'. Even though moose management in Finland includes a level of localised decision-making, there

may be room for improvement in terms of acknowledging and incorporating the perspectives of the indigenous Sami people. Scientific knowledge, local and indigenous knowledge can all contribute valid information for wildlife management. The challenge is for wildlife managers to incorporate these various forms of knowledge into their management regimes. An adaptive co-management regime that has the flexibility to deal with resource mobility and facilitates the genuine involvement of local people are the key features of the approach recommended here for the effective management of overabundant and mobile wildlife.

Chapter 10

Impact and conclusions

Entrance to the Aboriginal hunting area of Vulkathunha-Gammon Ranges National Park, Flinders Ranges, South Australia.

Introduction

This chapter concludes the thesis by presenting an overview of the impact of this research to date, making recommendations for further improvements to kangaroo management and suggesting future research directions.

This thesis addresses a need for better understanding of social and institutional issues that impact on kangaroo management and the kangaroo industry in South Australia. Commercial kangaroo harvest makes significant contribution to the environmental, social and economic sustainability of rangeland communities. However, in South Australia, where product demand is high, low harvest rates are presenting as an industry constraint.

This research highlights deficiencies of the current institutional regime for kangaroo management in South Australia and the flow on effect of limiting industry contributions to rangeland communities. The most pressing management issue is the inherently inflexible nature of property level quota allocation, the result of which, has been significant reduction in harvest rate and disparity between the formal rules of kangaroo management and the informal rules, or what happens 'on the ground'.

A lack of involvement of harvesters, landholders and Aboriginal people in decision-making for kangaroo management is also a major issue for kangaroo management in South Australia. This thesis argues that these people have a role in kangaroo management due to the significant local knowledge they hold about kangaroo density, movements and habits.

For kangaroo harvesters low prices paid in South Australia for product is the major issue. A lack of competition, largely due to the institutional regime of property level quota allocation, reduces the ability of South Australian harvesters to secure prices equivalent to their interstate counterparts.

These institutional and social issues for kangaroo management in South Australia require urgent and targeted attention. Recently the South Australian kangaroo management program has been revised. A draft kangaroo management plan has been

released by the South Australian Department for Environment and Heritage that directs attention towards some of the key issues identified by this research. The entire research process, from interactions with various industry stakeholders to the production of reports and publications presenting findings and recommendations, has influenced the future direction of kangaroo management in South Australia. These impacts are charted below.

Interactions and impacts of the research process

This research has had an important role in shaping the future of kangaroo management in South Australia. Interactions with the government agency responsible for kangaroo management, the South Australian Department for Environment and Heritage (SA DEH), and other agencies and individuals have had a direct influence on kangaroo management in South Australia. Table 8 outlines the major interactions that occurred during the research process. The discussion that follows describes the changes that these interactions effected.

The interactions that occurred during the research process (shown in Table 8) were not the only way in which the research process influenced kangaroo management in South Australia. Field work, participation in conferences and seminars, and the publication of peer-reviewed journal articles and research reports were on-going activities that occurred concurrently with the above interactions. All of these processes together impacted on the way that SA DEH currently approaches kangaroo management.

Table 1: Major interactions with government and research agencies during the research process

Year	SA DEH	Future of Australia's Threatened Ecosystems (FATE)*	Kangaroo managers in other States	Aboriginal commercial harvest proposal
2002	Funding application Discussion about management processes Data access	FATE representatives interested in research - agreed to keep communicating	Discussion about management processes	Met Aboriginal commercial harvester interested in business supplying culturally appropriate kangaroo carcasses to Aboriginal people
2003	Data access			Approached SA DEH re business idea Identified policy barrier to implementation Wrote submission to SA Minister for Environment and Conservation SA DEH instructed to change policy to pave the way for the business
2004	Briefing on preliminary research findings			Discussions with Aboriginal agencies and training organisations
2005	Data access Discussion of preliminary research findings for verification purposes	Participation in FATE program fieldwork with Aboriginal people in western New South Wales	Data access; Discussion of preliminary research findings for verification purposes	Discussions with the harvester about progress on health certification
2006	Data access; Peer review of draft RIRDC report (Thomsen and Davies 2007)		Data access	
2007	Briefing and discussion with SA DEH and FATE re research findings and implications for draft plan		Update on research outcomes	Explorations about how health inspection barriers could be overcome

* The FATE program is an initiative of the Australian Museum and the University of New South Wales that is investigating the commercial use of wildlife as a means of realising conservation goals.

Feedback of harvest statistics to landholders

One of the first impacts of the research was the identification of problems in data management. SA DEH staff found it difficult to easily access and collate the data required for this research and have since revised their data management process. Another significant change related to data management is the provision of harvest details to landholders. In the course of this research, I supplied property level harvest data, sourced from SA DEH, to research participants. This provided research

participants, for the first time, a summary of harvest levels and percentage of quota taken from their properties over recent years. Landholders were interested in this information and SA DEH has since changed its practice and now provides a summary of harvest rates to landholders on a regular basis.

Aboriginal whole carcass commercial harvest

Interactions with an Aboriginal person interested to develop a business around the supply of kangaroos to Aboriginal people in a culturally appropriate manner have resulted in SA DEH giving more attention to Aboriginal issues in kangaroo management. When I approached SA DEH on the issue in 2002, I learned that there were many uncertainties amongst SA DEH staff about Aboriginal rights to harvest kangaroos. Although there was no legislative barrier to doing so, SA DEH policy made no provision for commercial sale of whole kangaroo carcasses, skin-on, which is the cultural preference of Aboriginal people in some regions. SA DEH advised that the best way to proceed was to write to the Minister for Environment and Conservation. The submission I presented to the Minister is at Appendix 4. The response from the Minister's office was positive. SA DEH was instructed to pave the way for the business proposal to go ahead.

SA DEH staff were supportive of the proposal to develop a business based on culturally appropriate supply of kangaroo to Aboriginal people. SA DEH issued special quota that could be harvested on any property with landholders' permission. This overcame the barrier of access to quota that the Aboriginal harvester faced. However, implementation of the business proposal has also encountered barriers from health certification and inspection requirements. The Aboriginal harvester has since completed training and certification as a meat inspector. A further barrier remains to his business proposal: a health inspection for a kangaroo carcass cannot be completed unless the animal is fully gutted, and full gutting does not comply with Aboriginal cultural preference for whole kangaroo carcass. Currently, I am exploring with colleagues the possibility of using a field bioassay method to detect bacteria, or other pathogens, that could be secured without the need for gutting the animal.

The process of developing this business proposal demonstrates that Aboriginal perspectives in kangaroo harvest and management are being recognised by SA DEH, but there is a need for ongoing dialogue and commitment in this area.

2007 draft SA kangaroo management plan

In June 2007 SA DEH released the Draft Macropod Conservation and Management Plan for South Australia 2008-2012 (SA DEH 2007). This research, together with the FATE program and recent publications by other kangaroo management researchers (see for example Hacker et al. 2004; Wilson and Mitchell 2005) has influenced the development of this plan. A particular influence was a briefing on the findings from this research (as published in Thomsen and Davies 2007) held in January 2007. This meeting involved SA DEH staff, researchers from the FATE program, my principal supervisor, Jocelyn Davies, and me. We discussed the findings of this research and findings from the FATE program (see Ampt and Baumber 2006) and their implications for the forthcoming revision of the SA kangaroo management plan.

The 2007 draft kangaroo management plan looks very different to the previous management plan (SA DEH 2002) released at the beginning of this research project. It introduces major amendments to kangaroo management in South Australia, including:

- commitment to an adaptive management approach
- recognition of the complexity of property-level quota allocations and the link to low harvest rate
- allocation of quota to management regions rather than specific properties
- recognition of the diversity of Aboriginal perspectives regarding kangaroos and their management, and an understanding that Aboriginal people would like to be involved in decision-making processes
- commitment to supporting further research exploring social and institutional dimensions of kangaroo management
- commitment to developing linkages with other government agencies to improve kangaroo management.

The draft management plan specifically addresses some of the recommendations of this research, particularly those published in Thomsen and Davies (2007). Commitment to an adaptive management approach and removing the requirement for

quota to be allocated at the property level introduces a more flexible management system and addresses the lack of competition inherent in the previous system. Some effort has also been made to increase input from landholders, harvesters and Aboriginal people. However, as yet no incentive structures have been put into place in an attempt to increase harvest rate and harvester numbers. Table 9 shows the key recommendations of this research and the corresponding response in the draft Kangaroo Management Plan (SA DEH 2007).

Table 2: Impact of research recommendations on draft Kangaroo Management Plan

Key recommendation from this research	Response in draft Kangaroo Management Plan (SA DEH 2007)
Introduce flexibility to the management system	Commitment to an adaptive management approach (page 19) Quota allocated to regions rather than to specific properties (page 13)
Address lack of competition	Quota allocated to regions rather than to specific properties (page 13)
Increase stakeholder input	Restructuring of the representative Kangaroo Management Reference Group (page 34) More consultation/contact with people 'on the ground' by kangaroo program staff (pers. comm., Ginman 2007)
Boost harvester numbers and introduce incentives	_

The future of kangaroo management in South Australia

The revised draft kangaroo management plan represents a significant step forward for kangaroo management in South Australia. SA DEH is to be particularly commended on its commitment to adaptive management. However, in Chapter 9 adaptive co-management was identified as the key to successfully managing overabundant and mobile wildlife resources because it contains the flexibility to respond to mobility and incorporates the knowledge and skills of people who directly manage the resource, that is people 'on the ground'. An adaptive co-management approach requires more attention to appropriate involvement of local people in policy and management processes than currently features in the South Australian draft kangaroo management plan.

There are two existing mechanisms for local involvement – an informal process of face-to-face contact with industry stakeholders and the formal process of

representation on the Kangaroo Management Reference Group. The Kangaroo Management Reference Group provides advice to SA DEH "on matters relating to the management of commercial harvest and kangaroo management in South Australia" (SA DEH 2007:34). The group is comprised of representatives from industry, government, landholder organisations, an Aboriginal organisation, animal welfare interests, conservation groups and kangaroo harvesters.

A new initiative for local involvement included in the draft management plan is informal consultations with industry stakeholders by SA DEH to develop greater capacity for information sharing between stakeholders and SA DEH (Ginman 2007). This is an important first step towards greater responsiveness to the information provided by people 'on the ground'. But SA DEH needs to explore ways to take this initiative further and deliver a process for genuine power sharing to landholders, kangaroo harvesters and Aboriginal people.

There are existing structures that could facilitate the flow of information from people 'on the ground' to SA DEH in order to influence management policy and decision-making. The existing South Australian Arid Lands Natural Resource Management Board (SAAL NRM Board) offers a potential mechanism for engaging local people in kangaroo management (Government of South Australia 2006). The SAAL NRM Board is the peak body responsible for sustainable management of arid lands, where most commercial kangaroo harvest occurs. The engagement of local communities in management is already a priority for the SAAL NRM Board. Six regional NRM groups within the SAAL NRM Board region are responsible for soil, water, plant and animal management activities within their locality. The groups advise the SAAL NRM Board on management issues and the Board makes strategic decisions and provides leadership and direction to the regional NRM groups.

The SAAL NRM Board, with its regional NRM groups, may be an appropriate vehicle for developing an adaptive co-management approach to kangaroo management. This existing structure could offer landholders and harvesters a link to monitoring and decision-making processes in kangaroo management. A small number of landholders participate on regional NRM Boards and bring issues forward on behalf of themselves and other landholders. However, the majority of landholders are

not well represented, and neither are harvesters nor Aboriginal people. To improve representation and the flow of information, Natural Resource Management Officers currently employed by NRM groups to liaise with landholders on land management issues, could also generate dialogue about kangaroo management directly with landholders, harvesters and Aboriginal people. Information could then flow from the SAAL NRM Board to the Kangaroo Management Reference Group and influence kangaroo management outcomes.

In this way, the SAAL NRM Board and regional NRM groups could provide a mechanism for people with management interests in kangaroos to provide information to the management system and receive feedback. This structure follows the recommendation of Olsson et al. (2004) for nested or layered institutions for resource management (see also Ostrom 2005). Using existing structures would facilitate the dissemination of information and improve the quality and volume of information that is fed into the kangaroo management system at relatively low cost.

For the system to be a genuine adaptive co-management arrangement, power must be shared between government regulators, industry stakeholders and people ‘on the ground’. The overarching decision-making mechanism for kangaroo management needs to value information from these various sources. The overall structure that I envisage for an adaptive co-management regime for South Australian kangaroo management is shown in Figure 3. In Figure 3, the South Australian Kangaroo Management Group is suggested as an appropriate structure to represent various interests in kangaroo management, but there is a need to develop a stronger linkage between the SAAL NRM Board and the Kangaroo Management Reference Group. The commitment of SA DEH to developing linkages with other organisations to improve the efficiency of kangaroo management makes this a promising prospect.

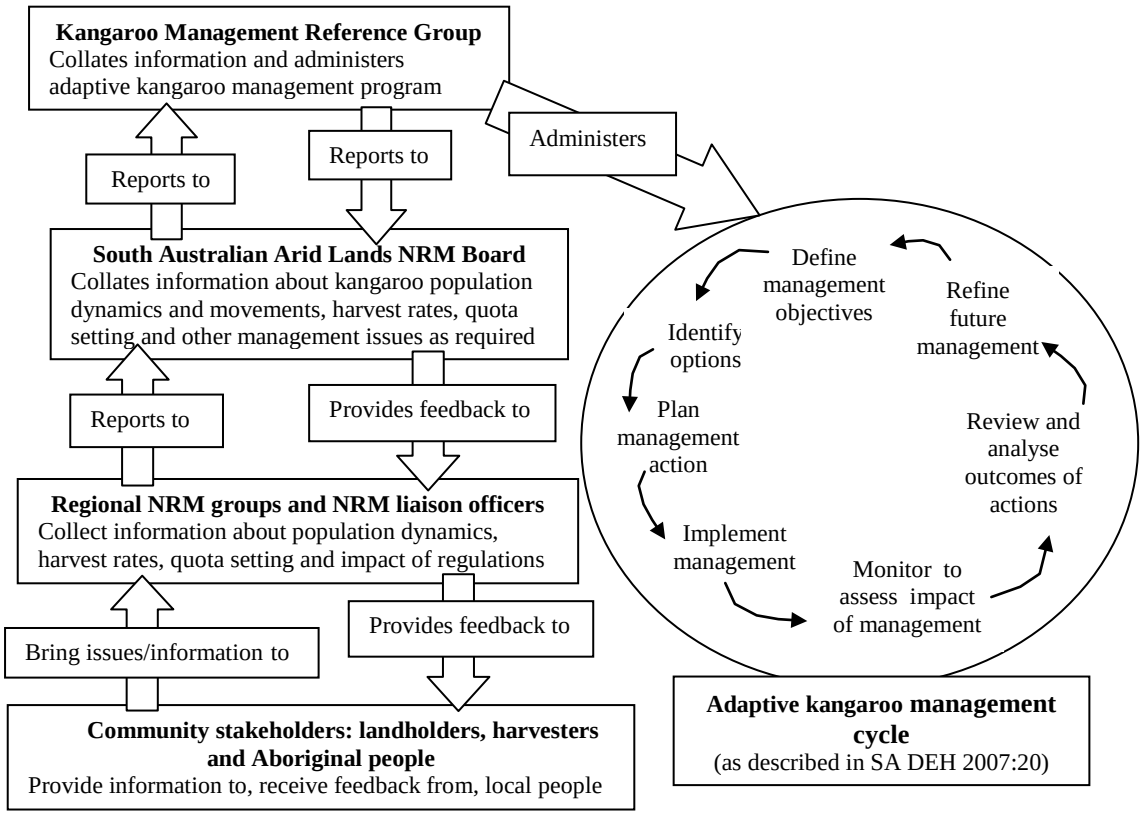

Figure 1: An information flow diagram for adaptive co-management of kangaroo harvest in South Australia.

Future research directions

This research has illuminated the institutional and social factors that influence kangaroo management in South Australia. The following areas are suggested for future research based on reflection on the research process and results.

- The current restructuring of the South Australian kangaroo management system needs to be monitored in terms of effectiveness in producing desired outcomes on harvest rates and stakeholder satisfaction with the kangaroo management system.

- The institutional and social dimensions of kangaroo harvest in other States also requires research attention, as other Australian States operate under similar yet different, institutional frameworks.

- Similar work should be undertaken in other indigenous cultural regions in order to gain a broader, yet more detailed, picture of indigenous perspectives across more than the two regions studied.

- Examine more closely the formal and informal rules of use in the management of other overabundant and mobile wildlife resources in Australia and in other countries.

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Appendix 1: Timeline and duration of field work activities

Considerable time was spent in the field presenting the research to participants and 'scoping' interest in the research, collecting data and then verifying results. The Table below shows the dates and destinations of field work activities.

Date	Destination	Duration (days)	Purpose
20/9/02 – 29/9/02	Marla/Oodnadatta region	10	Scoping study
6/10/02 – 14/10/02	Port Augusta region	9	Scoping study and pilot interviews
4/12/02 – 12/12/02	Flinders Ranges region	9	Scoping study
18/01/03 – 25/01/03	Marla/Oodnadatta region	8	Scoping study
9/03/03 – 20/03/03	Marla/Oodnadatta region	12	Data collection
30/06/03 – 24/07/03	Port Augusta, Flinders Ranges and Marla/Oodnadatta regions	25	Data collection
22/09/03 – 6/10/03	Flinders Ranges and Port Augusta regions	15	Data collection
26/01/04 – 29/01/04	Flinders Ranges region	4	Verification
24/02/04 – 3/03/04	Marla/Oodnadatta region	8	Verification
12/08/05 – 19/08/05	Port Augusta region	7	Verification

Note the time lag between the two final verification field trips. Maternity leave interrupted the research process during this period.

Appendix 2: Interview question guides

Appendix 2a: Interview question guide - meat processors

General questions

How long have you been involved in the kangaroo industry and how did you get started?
What are the quotas for the properties where you have harvesters working? Is the full quota for each property harvested?
How often does a harvester visit the properties listed with you?
Do you think there are enough harvesters in SA, too few or too many?

Information/communication networks

Who is providing information to the public?
Where do you go for information?
Who comes to you for information?
Can you draw a picture of the information/communication network?
Is there enough communication between industry players? If no, how can this be improved?

Regulations and policy

What are the licensing procedures for you as a meat processor?
How are regulations and policy made?
Are the goals and strategies of the SA KMP clear and appropriate?
How is quota set?
How do regulations and policy impact on you?
Do you have the opportunity to comment on changes to policy/regulations?
Why does SA not meet quota?

Rights and interests

Who owns kangaroos?
Who are the other individuals/groups who have rights and interests in kangaroos?
Who else benefits from the harvest of kangaroos and in what way?

Economic information

What are the costs involved in your participation in the industry?
What is your average weekly income?
What is your post-tax annual income?
Do you pay royalty to landholders? How much? Should landholders get an access fee/royalty?
How much per kilo do you pay to harvesters?
When was the last per kilo price increase for harvesters?
At present meat processors buy the tags; in your view, is this appropriate? If no, who should buy tags?
What is the main market for your product?
Are you at all times able to meet market demand?
Do you think that the anti-roo lobby has an impact on the industry?

Other

In your opinion, what are the main reasons that landholders chose to engage in commercial harvest?
What other values do kangaroos hold?
What would happen if there was no commercial kangaroo harvest?
Do you feel pressured by other stakeholders at any time?
Are the tags issued for a property always used only on that property? What is the scale/magnitude of tag swapping? Why does it happen?
Are there any issues that you'd like to discuss that we haven't already covered?

Appendix 2b: Interview question guide - kangaroo harvesters

General questions

How long have you been involved in the kangaroo industry and how did you get started?
Which properties do you take kangaroos from? How many properties do you take kangaroos from in total?
How often do you visit each property? Is the number of visits adequate, too few or too many?
What are the quotas for these properties where you shoot? Is the full quota for each harvested?
Do you think there are enough harvesters in SA, too few or too many?
Which MP do you work for?

Information/communication networks

Who is providing information to the public? Where do you go for information?
Who comes to you for information?
Can you draw a picture of the information/communication network?
Is there enough communication between industry players? If no, how can this be improved?

Regulations and policy

What are the licensing procedures for harvesters?
How are regulations and policy made?
Are the goals and strategies of the SA KMP clear and appropriate?
How is quota set? How do regulations and policy impact on you?
Do you have the opportunity to comment on changes to policy/regulations?
Do you receive updates from government agencies about changes to regulations/policy?
Is SAs quota limiting on a property scale?
Why does SA not meet quota?

Rights and interests

Who owns kangaroos?
Who are the other individuals/groups who have rights and interests in kangaroos?
Who else benefits from the harvest of kangaroos and in what way?
Do Aboriginal people visit the properties where you harvest to also harvest kangaroos?
What do you think about Aboriginal people harvesting kangaroos from pastoral land?

Economic information

What are the costs involved in your participation in the industry, economic and non-economic?
What is the price paid to you per kilo?
When was the last per kilo price increase for harvesters?
What is the average amount that you receive per roo?
What is the average cost to shoot per roo?
How many roos do you need to take per night & per week to make a living?
What is your average weekly income?
Should landholders get royalty/access fee?
Do you pay royalty to landholder? Or does the MP you work for pay a royalty?
At present meat processors buy the tags; in your view, is this appropriate? If no, who should buy tags?
What is your annual income?
What is the main market for the product?
Is market demand being met at all times?
Do you think that the anti-roo lobby has an impact on the industry?

Other

In your opinion what are the main reasons that landholders chose to engage in commercial harvest?
What other values do kangaroos hold?
What would happen if there was no commercial kangaroo harvest?
Are the tags issued for a property always used only on that property? What is the scale/magnitude of tag swapping? Why does it happen?
Do you feel pressured by other stakeholders at any time?
Are there any issues that you'd like to discuss that we haven't already covered?

Appendix 2c: Interview question guide - landholders

General questions

How long have you been a pastoralist/pastoral station manager?
What is the size of this property and what livestock are run on this property?
How long have kangaroos been harvested on this property and how did you get involved?
What is the quota for this property? Is the full quota taken each year?
How many harvesters harvest on this property?
How often does a harvester visit your property? Is the number of visits adequate, too few or too many?
Do you think there are enough harvesters in SA, too few or too many?
What is the main reason that you engage a harvester? ie can you give me reasons specific to this property?
What other values do kangaroos hold?
What would happen if there was no commercial kangaroo harvest?

Information/communication networks

Who is providing information to the public? Where do you go for information?
Who comes to you for information?
Can you draw a picture of the information/communication network?
Is there enough communication between industry players? If no, how can this be improved?

Regulations and policy

What is the process for getting a harvest permit and how long does it take?
How are regulations and policy made?
Are the goals and strategies of the SA KMP clear and appropriate?
How is quota set?
How do regulations and policy impact on you?
Do you have the opportunity to comment on changes to policy/regulations?
Why does SA not meet quota?

Rights and interests

Who owns kangaroos?
Who are the other individuals/groups who have rights and interests in kangaroos?
Who else benefits from the harvest of kangaroos and in what way?
Do Aboriginal people visit this property to harvest kangaroos?
What do you think about Aboriginal people harvesting kangaroos from pastoral land?

Economic information

What are the costs involved in your participation in the industry?
Do you receive a royalty? If no, do you think that you should receive royalty & how much should it be?
Discussion about the 'Grigg' proposal. Why has the 'Grigg' proposal not yet been taken up by landholders? At present meat processors buy the tags; in your view, is this appropriate? If no, who should buy tags?
What do you think is the main market for product?
Do you think that the anti-roo lobby has an impact on the industry?

Other

Do you feel pressured by other stakeholders at any time?
Are there any issues that you'd like to discuss that we haven't already covered?

Appendix 2d: Interview question guide - Aboriginal people

Significance of kangaroos

Can you describe the importance of kangaroos?

- cultural
- health/diet/nutrition
- other

How can this importance be explained to whitefellas?

Access to kangaroos

Where do you hunt kangaroo?

Is it easy or hard to hunt kangaroo?

What makes it easy and what makes it hard?

Legislation and regulations

Do you understand the whitefella rules about kangaroos?

Where are you allowed to hunt kangaroo?

How many kangaroos can you take?

Do whitefella rules make it hard for Aboriginal people?

How can the rules be made better?

Aboriginal harvest

Can you describe the level of harvest?

Who hunts kangaroos?

Who distributes the meat?

Is there a preferred kangaroo species?

Rights and interests

Who owns wildlife?

Who owns kangaroos?

What are your rights and interests in kangaroos?

What rights and interests do other people have?

Does the recognition of native title influence your rights to wildlife?

The commercial kangaroo industry

What are your views and issues regarding the commercial kangaroo industry?

Do you see opportunities for Aboriginal people in this industry?

What involvement (if any) is appropriate for Aboriginal people?

Can the kangaroo industry help Aboriginal people?

Is there anything else that you would like to discuss that we haven't already covered?

Appendix 3: Findings presented to research participants

Appendix 3a: Research findings discussed with non-indigenous research participants during member checking

1. **There is lack of flexibility in the South Australian kangaroo management system**
   - Landholders and kangaroo harvesters state that tag swapping occurs as a response to a system which lacks the flexibility to deal with localised fluctuations in population.
   - Greater flexibility in the system would increase honesty (ie reduce tag swapping).
   - Kangaroos move around in response to environmental conditions which may change quite quickly, but quota is allocated at the property level based on a population monitoring event that happened in the previous calendar year. The lack of flexibility in quota allocation may have implications for sustainability in rangeland landscapes.
2. **The 'Grigg' proposal does not make economic sense to most landholders**
   - Most landholders see value in the idea in terms of improving land condition but see problems in using a common property resource as their principle income.
   - Ownership is a big issue for landholders because they recognise that kangaroos are mobile animals and are concerned about having a lack of control over their income base.
   - Economically, sheep and cattle are relatively stable earners for pastoralists and to deviate from this mode of production landholders need to be sure of economic returns equivalent to their current production systems.
   - Currently, landholders see economic value in kangaroos only as a supplement to their traditional production systems.
3. **Some kangaroo harvesters are struggling economically**
   - A majority of harvesters say they need to be paid more per kg.
   - Harvesters supply carcasses to one meat processor. They accept the price paid per kilogram by this meat processor, but can change meat processors if their landholder agrees to the change. Thus, seeking a higher price for the product is reliant on landholders agreeing to the change.
4. **Just a few kangaroo harvesters hold the harvest rights to (or tags) for the greatest proportion of the quota**
   - System of one harvester per property has resulted in a situation where a few harvesters hold more 'country' and tags/quota than they could possibly harvest in one year.
   - There are no restrictions on how many properties one harvester can hold harvest rights to and tags for.
   - Meanwhile other harvesters are struggling with only few properties and control of only small amount of tags/quota. It is not easy to gain more country (and therefore tags) because country is held tightly by the harvester who has developed a relationship with the landholder.
5. **Lack of confidence in the aerial survey for population monitoring**
   - A majority of harvesters and landholders say that the aerial survey is not a reliable tool for population estimation.
   - Harvesters and landholders say that they could contribute to population monitoring.
   - There is a need for more communication with these people who are 'on the land', in particular direct consultation and the opportunity for kangaroo management officers visit pastoral stations and "see for themselves".

6. **The anti-kangaroo harvest lobby has an impact on the industry**
   - Some landholders and harvesters were concerned about impacts of the anti-kangaroo harvest lobby but others were not concerned at all and do not see it as a threat to the industry.
   - Landholders and harvesters who identify the anti-kangaroo harvest lobby as a concern for the industry would not alter their kangaroo management practices as a result of pressure from this minority group.
   - Meat processors, landholders and harvesters state that the anti harvest lobby has greatest impact on overseas markets and many feel that there is a need for the government to support the industry in this respect.
7. **The kangaroo industry makes significant contributions to the social, economic and ecological sustainability of rangeland communities**
   - Social - the kangaroo industry brings multi skilled people to rural and remote areas.
   - Economic - the industry contributes to the rural economy in many ways.
   - Ecological - commercial kangaroo harvest assists landholders to manage total grazing pressure on pastoral properties.
8. **Kangaroo management goals of landholders and harvesters are different**
   - A majority of landholders are seeking a reduction in the overall number of kangaroos on their property.
   - All harvesters aim to maintain kangaroo populations on the properties where they harvest.
   - Most landholders are aware of the disparity in management goals – so why do they continue to engage a harvester? There are three reasons: i) When there is an influx of kangaroos due to localised environmental conditions the harvester is able to respond to that situation and reduce the impact of short term kangaroo overabundance. ii) Kangaroo harvest is a mechanism that acts to reduce the impact of the boom and bust nature of kangaroo populations. That is, harvesting kangaroos will smooth out the peaks and troughs of kangaroo populations. iii) All landholders value the social and economic contribution that harvesters make in the rangelands.
9. **Culling is a waste of a valuable resource and should not be permitted**
   - A majority of all research participants, this includes Aboriginal people, landholders, harvesters and meat processors, state that kangaroos should not be culled on pastoral leases or in national parks (culling involves shooting a kangaroo and not utilising the meat and/or skin).
   - The main reason for objections to culling is the waste of a valuable resource.
10. **Factors that contribute to South Australia taking a small proportion of the harvest quota**
    - few harvesters controlling too many tags/holding too many properties
    - lack of flexibility in the quota allocation system
    - low price paid to harvesters
    - remoteness/few towns and lack of infrastructure
    - geography/accessibility
    - economics – of accessibility; price paid; remoteness
    - large properties in South Australia with one harvester per property
    - not enough harvesters
    - low harvester recruitment rate
    - non –economic costs of being a harvester.

Appendix 3b: Research findings presented to Aboriginal people in the northern Flinders Ranges for verification and comment

This report presents a summary of issues raised in discussions with Aboriginal people in the northern Flinders Ranges about the commercial harvest of kangaroos. The discussions took place during two field trips to the region over the past year. A report about the findings is being prepared for AIATSIS and will be finalised in April 2004. We would like people to tell us if this summary describes the main issues for Aboriginal research participants. This is important because the final report will be used to inform policy makers, industry and government representatives about Aboriginal perspectives on commercial kangaroo harvest.

The common themes found to be important issues for Aboriginal people are:

Kangaroo and euro have cultural significance to Aboriginal people of the Flinders Ranges.

- It is important to promote understanding about cultural values of kangaroo and euro to government, the kangaroo industry and the public.

It is wrong to waste kangaroo carcasses when kangaroos are culled in national parks. It is also wrong that sometimes the tails of kangaroos are wasted in commercial harvest.

- It is important to tell industry and government that harvested kangaroos should be used and not wasted.
- The culling of kangaroos in national parks should be done by Aboriginal people.

Access to national parks and pastoral leases for hunting.

- National Parks and Wildlife does not like Aboriginal people hunting in Flinders Ranges National Park. Some national parks staff have told Aboriginal people that they can only hunt in the park using a spear and boomerang. Sometimes staff may shoot a kangaroo and give it to Aboriginal people. An indigenous hunting area is needed in this park (for example at Dingley Dell).
- The indigenous hunting area in Gammon Ranges National Park has not been proclaimed by the Minister to make it legal. The hunting area only includes plains country for hunting red kangaroos but people also need an area that includes hilly country so they can hunt euro. Hunting areas should be located closer to where people live for easier access.
- Pastoralists and police do not always respect the rights of Aboriginal people to hunt on pastoral leases. They need to be better educated about Aboriginal peoples' rights.

Communication with government and opportunities for involvement in decision-making.

- Better communication with government people is needed (especially national parks staff).
- Some ideas for ways that Aboriginal people can have a say about kangaroo management are regional indigenous consultative committees, visits by government representatives to talk about kangaroo management and invitations for Aboriginal people to attend and participate in relevant meetings.

Potential benefits from the commercial harvest of kangaroos for Aboriginal communities.

- A financial levy that can be used for the benefit of Aboriginal communities like scholarships, business assistance or other types of community development funding.
- Employment opportunities in the kangaroo industry.

Appendix 3c: Research findings presented to Anangu research participants for verification and comment.

Appendix 4: Submission to the Minister for Environment and Conservation

Commercial in Confidence

Attention: The Hon. John Hill, Minister for Environment and Conservation

This paper briefly outlines aspects of a business idea proposed by Mr Ivan McKenzie of Port Augusta. Mr McKenzie, a trained and experienced professional kangaroo harvester, proposes an indigenous business venture based on the supply of kangaroo carcasses to indigenous people. As an indigenous person, Mr McKenzie has the ability to supply kangaroos to Aboriginal people that have been harvested and prepared using culturally appropriate methods. This business idea is unique because there is no other kangaroo product supplier that caters for the cultural protocols of Aboriginal people. The uniqueness of this proposal means that it does not fit neatly into the framework of kangaroo management in South Australia, so assistance from the Minister for Environment and Conservation is needed.

Why this proposal is important

In the Port Augusta region there is a demand for access to kangaroos that have been harvested, processed and prepared in the manner required by Aboriginal customary law. Access to such kangaroos is important to the physical and cultural health of Aboriginal people. The factors that make this need for access to culturally appropriate kangaroo products are:

- the cultural importance of kangaroos to Aboriginal people
- many Aboriginal people will not eat kangaroo meat that has been harvested and processed in the 'whitefella way'
- the health benefits of eating kangaroo for Aboriginal people
- practical difficulties faced by Aboriginal hunters, for example access to a gun and vehicle, and the problem of Aboriginal people feeling secure and confident when accessing pastoral leases for hunting even though native title provides such rights.

What needs to happen

Mr McKenzie has been working hard on this proposal over the past year. He is currently undertaking training to meet requirements of meat hygiene regulations and has accessed assistance in preparing a business plan. However, the major problem being faced is access to kangaroo tags. The South Australian kangaroo harvesting system is essentially a 'closed shop' in that kangaroo harvesters control the tags for the properties where they shoot. One harvester can control ay number of properties, and tags, which makes it difficult for 'outsiders' to gain access to tags. The proposal being put forward by Mr McKenzie is that harvest for an indigenous market could operate within the existing framework through the issuance of special tags that could be used on any property where Mr McKenzie has permission from the landholder. Access to between 4,000 and 5,000 tags would be sufficient to begin the venture, subject to review after the first year. This number of tags represents less than 1% of the total quota issued for the State. Furthermore the South Australian kangaroo harvest has rarely approached the issued quota in the last 28 years. Together these facts indicate that Mr McKenzie's proposal is sustainable in ecological terms and that his proposal will not have an adverse impact on non-indigenous stakeholders.

Conclusion

This proposal demonstrates that there is great potential for Aboriginal people to become involved in the kangaroo industry in ways that are culturally appropriate. Mr McKenzie proposes a system where kangaroos are supplied to Aboriginal people according to the requirements of Aboriginal customary law, and he sees this as important to improving the physical and cultural health of Aboriginal people in the Port Augusta region. The management of kangaroos in Australia has not previously recognised the unique requirements of Aboriginal people. This proposal provides an opportunity for exemplary leadership on the issue of equitable benefits for indigenous people in a way that produces positive outcomes for landholders, the environment and the broader community.

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